

FCC LISTED, REGISTRATION
NUMBER: 720267

Test report No:

IC LISTED REGISTRATION
NUMBER IC 4621A-1

NIE: 48688RRF.001A1

Test report (Modification 1)

REFERENCE STANDARD:

USA FCC Part 22 & Part 24 & Part 27

CANADA IC RSS-132, RSS-133, CANADA IC RSS-139, RSS-130

Identificación del objeto ensayado.....: Identification of item tested	Wireless sensor node for the Internet of Things
Marca Trademark	Libelium
Modelo y/o referencia tipo Model and /or type reference	Waspmote Plug & Sense! 4G US
Other identification of the product	FCC ID: XKM-WPS-4G-V1 IC: 8472A-WPS4GV1
Final HW version	1.0
Final SW version	1.0
IMEI TAC	35894205
Características Features	Can communicate with 2G, 3G and 4G/LTE networks. GNSS (A-GPS) receiver. USA and Canada version, AT&T. Contains an LE910 NAG chipset. Includes 2 cellular antennas for diversity gain.
Fabricante Manufacturer	LIBELIUM COMUNICACIONES DISTRIBUIDAS S.L C/ Escatrón 16 (Edificio Libelium), CP: 50014, Zaragoza (SPAIN)
Método de ensayo solicitado, norma.....: Test method requested, standard	USA FCC Part 22 10-1-15 Edition. USA FCC Part 24 10-1-15 Edition. USA FCC Part 27 10-1-15 Edition. CANADA IC RSS-132 Issue 3, Jan. 2013. CANADA IC RSS-133 Issue 6, Jan. 2013. CANADA IC RSS-139 Issue 3, Jul. 2015. CANADA IC RSS-130 Issue 1, Oct. 2013. Measurement Guidance 971168 D01 v02r02 for certification of Licensed Digital Transmitters. ANSI/TIA-603-D (2010).
Resultado.....: Summary	IN COMPLIANCE
Aprobado por (nombre / cargo y firma) Approved by (name / position & signature)	A. Llamas RF Lab. Manager
Fecha de realización Date of issue	2016-09-16

Formato de informe No.: Report template No	FDT11_18
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Competences and guarantees

AT4 wireless is a laboratory with a measurement facility in compliance with the requirements of Section 2.948 of the FCC rules and has been added to the list of facilities whose measurements data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 720267.

AT4 wireless is a laboratory with a measurement site in compliance with the requirements of RSS 212, Issue 1 (Provisional) and has been added to the list of filed sites of the Canadian Certification and Engineering Bureau. Reference File Number: IC 4621A-1.

In order to assure the traceability to other national and international laboratories, AT4 wireless has a calibration and maintenance program for its measurement equipment.

AT4 wireless guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at AT4 wireless at the time of performance of the test.

AT4 wireless is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

IMPORTANT: No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of AT4 wireless.

General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of AT4 wireless.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of AT4 wireless and the Accreditation Bodies.

Uncertainty

Uncertainty (factor $k=2$) was calculated according to the AT4 wireless internal document PODT000.

Usage of samples

Samples undergoing test have been selected by: **the client**.

Sample S/01 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
45355E/187	Sensor node with wireless communication	Waspnote Plug & Sense! 4G US	---	2015-10-26
45355E/063	Luminosity probe	Plug & Sense	---	2015-10-26
45355E/174	Antenna RF 2G/3G/4G	---	---	2016-02-01
45355E/178	Antenna RF 2G/3G/4G	---	---	2016-02-01
45355E/179	Antenna RF 2G/3G/4G	---	---	2016-02-01
45355E/044	Battery adapter	---	---	2015-10-26

1. Sample S/01 has undergone the test(s).

All tests indicated in appendix A.

Test sample description

The test sample consists of a wireless communication module which receives data from sensors and sends information with its wireless radio. It is battery powered and can be easily programmed.

Identification of the client

LIBELIUM COMUNICACIONES DISTRIBUIDAS S.L.

C/ Escatrón 16 (Edificio Libelium), CP: 50014, Zaragoza (SPAIN)

Testing period

The performed test started on 2016-02-01 and finished on 2016-02-02.

The tests have been performed at AT4 wireless.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

In the semianechoic chamber the following limits were not exceeded during the test.

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω
Normal site attenuation (NSA)	< ±4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz)
Field homogeneity	More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).

Modifications to the reference test report

It was introduced the following modifications in respect to the test report number 48668RRF.001 related with the same samples, in the next clauses and sub-clauses:

Clauses / Sub-clauses	Modification	Justification
Cover sheet / Other identification of the product/IC	IC code is changed to 8472A-WPS4GV1	Typographical error

This modification test report cancels and replaces the test report 48668RRF.001.

Remarks and comments

1: Test not requested. Only radiated spurious emissions tests were requested.

2: Used instrumentation.

Radiated Measurements

		Last Cal. date	Cal. due date
1.	Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2.	BiconicalLog antenna ETS LINDGREN 3142E	2014/03	2017/03
3.	Multi Device Controller EMCO 2090	N.A.	N.A.
4.	Double-ridge Guide Horn antenna 1-18 GHz SCHWARZBECK BBHA 9120 D	2013/11	2016/11
5.	Broadband Horn antenna 18-40 GHz Schwarbeck BBHA 9170	2014/03	2017/03
6.	EMI Test Receiver R&S ESU 40	2014/02	2016/02
7.	Spectrum analyser Rohde & Schwarz FSW50	2015/12	2017/12
8.	RF pre-amplifier 10 MHz-6 GHz SCHWARZBECK BBV9743	2015/03	2016/03
9.	RF pre-amplifier 1-18 GHz BONN ELEKTRONIK BLMA 0118-3A	2015/05	2016/05
10.	RF pre-amplifier 18-40 GHz BONN ELEKTRONIK BLMA 1840-1M	2015/12	2017/12
11.	Universal Radio communication Tester R&S CMW500	2014/09	2016/09

Testing verdicts

Not applicable	N/A
Pass	P
Fail	F
Not measured	N/M

FCC PART 22/IC RSS-132 PARAGRAPH	VERDICT			
	NA	P	F	NM
Clause 22.913/RSS-132 Clause 5.4: RF output power				NM ¹
Clause 2.1047/RSS-132 Clause 5.2: Modulation characteristics				NM ¹
Clause 22.355/RSS-132 Clause 5.3: Frequency stability				NM ¹
Clause 2.1049: Occupied Bandwidth				NM ¹
Clause 22.917/RSS-132 Clause 5.5: Spurious emissions at antenna terminals				NM ¹
Clause 22.917/RSS-132 Clause 5.5: Radiated emissions		P		

1: See section "Remarks and comments".

FCC PART 24/IC RSS-133 PARAGRAPH	VERDICT			
	NA	P	F	NM
Clause 24.232/RSS-133 Clause 6.4: RF output power				NM ¹
Clause 2.1047/RSS-133 Clause 6.2: Modulation characteristics				NM ¹
Clause 24.235/RSS-133 Clause 6.3: Frequency stability				NM ¹
Clause 2.1049: Occupied Bandwidth				NM ¹
Clause 24.238/RSS-133 Clause 6.5: Spurious emissions at antenna terminals				NM ¹
Clause 24.238/RSS-133 Clause 6.5: Radiated emissions		P		

1: See section "Remarks and comments".

FCC PART 27/IC RSS-139/ IC RSS-130 PARAGRAPH	VERDICT			
	NA	P	F	NM
Clause 27.50 / RSS-139 Clause 6.5. / RSS-130 Clause 4.4.: RF output power				NM ¹
Clause 2.1047 / RSS-139 Clause 6.2. / RSS-130 Clause 4.1.: Modulation characteristics				NM ¹
Clause 27.54 / RSS-139 Clause 6.4. / RSS-130 Clause 4.3.: Frequency stability				NM ¹
Clause 2.1049: Occupied Bandwidth				NM ¹
Clause 27.53 / RSS-139 Clause 6.6. / RSS-130 Clause 4.6.: Spurious emissions at antenna terminals				NM ¹
Clause 27.53 / RSS-139 Clause 6.6. / RSS-130 Clause 4.6.: Radiated emissions		P		

1: See section “Remarks and comments”.

Appendix A – Test result for FCC Part 22/IC RSS-132

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TEST RESULTS FOR FCC PART 22 AND IC RSS-132

TEST CONDITIONS

Power supply (V):

$$V_{\text{nom}} = 3.6 \text{ Vdc}$$

$$V_{\text{max}} = \text{N/A}$$

$$V_{\text{min}} = \text{N/A}$$

The subscripts nom, min and max indicate voltage test conditions (nominal, minimum and maximum respectively, as declared by the applicant).

N/A: Not Applicable.

Type of power supply = DC voltage from rechargeable battery.

Type of antenna = External attachable antennae.

TEST FREQUENCIES:

GPRS AND EDGE MODULATION

Lowest channel (128): 824.2 MHz

Middle channel (190): 836.6 MHz

Highest channel (251): 848.8 MHz

WCDMA AND HSUPA MODULATION

Lowest channel (4132): 826.4 MHz

Middle channel (4182): 836.4 MHz

Highest channel (4233): 846.6 MHz

LTE. QPSK AND 16QAM MODULATION (BAND V)

	Channel (Frequency, MHz)			
	BW = 1.4 MHz	BW = 3 MHz	BW = 5 MHz	BW = 10 MHz
Lowest	20407 (824.70)	20415 (825.50)	20425 (826.50)	20450 (829.00)
Middle	20525 (836.50)	20525 (836.50)	20525 (836.50)	20525 (836.50)
Highest	20643 (848.30)	20635 (847.50)	20625 (846.50)	20600 (844.00)

Radiated emissions

SPECIFICATION

FCC § 22.917

RSS-132. Clause 5.5.

METHOD

The measurement was performed with the EUT inside an anechoic chamber. The spectrum was scanned from 30 MHz to at least the 10th harmonic of the highest frequency generated within the equipment.

The EUT was placed on a 1.5 meter high non-conductive stand at a 3 meter distance from the measuring antenna for measurements below 1 GHz and at 1 m distance for measurements above 1 GHz.

Detected emissions were maximized at each frequency by rotating the EUT and adjusting the measuring antenna height and polarization. The maximum meter reading was recorded. The radiated emissions were measured with peak detector and 1 MHz bandwidth.

Each detected emission at less than 20 dB below the limit is substituted by the Substitution method, in accordance with the ANSI/TIA/EIA-603-D.

Measurement Limit:

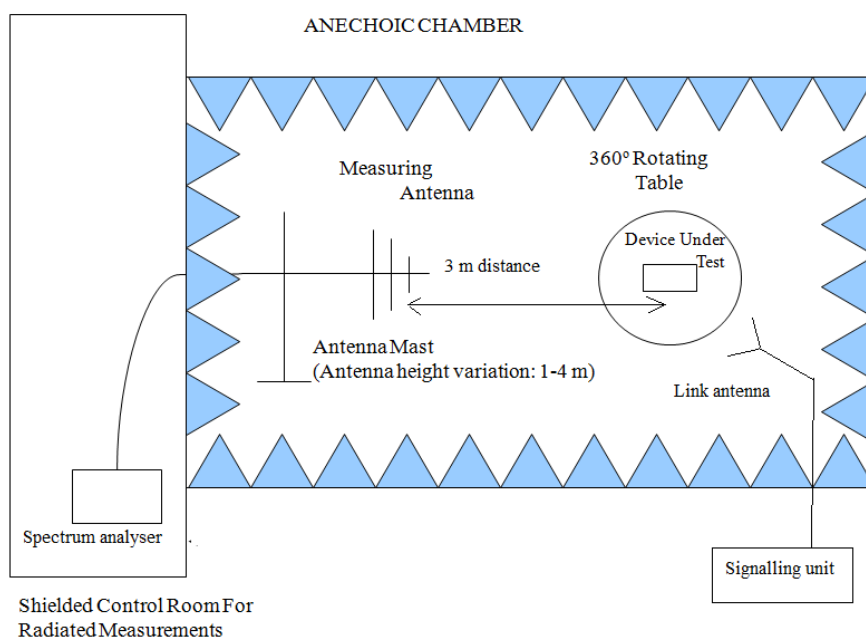
According to specification, the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. P in watts.

At P_o transmitting power, the specified minimum attenuation becomes $43 + 10 \log (P_o)$ and the level in dBm relative P_o becomes:

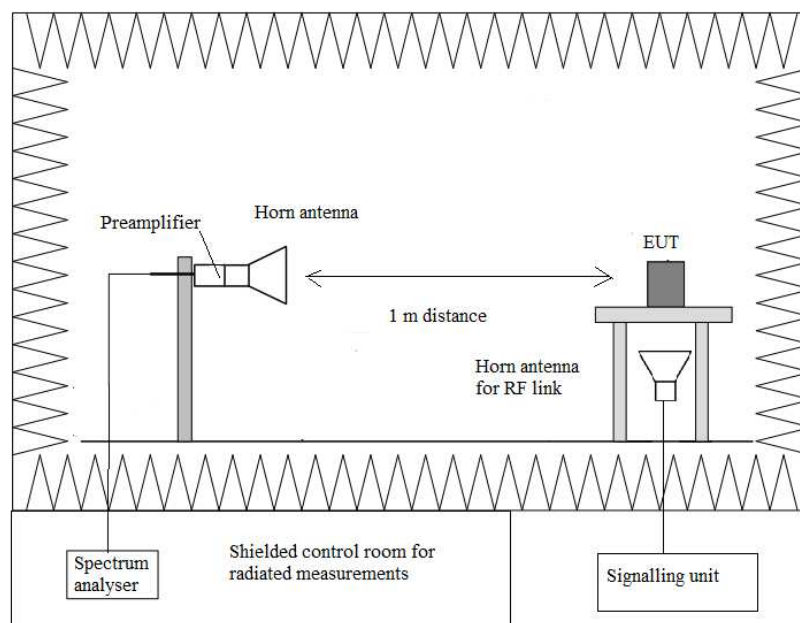
$$P_o \text{ (dBm)} - [43 + 10 \log (P_o \text{ in mwatts}) - 30] = -13 \text{ dBm}$$

TEST SETUP

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



RESULTS

GPRS AND EDGE MODULATION

A preliminary scan determined the GPRS modulation as the worst case. The following tables and plots show the results for GPRS modulation.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain G_i (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
1648.50	-19.93	Vertical	-30.91	1.80	8.63	-24.08

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain G_i (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
1673.30	-18.48	Vertical	-29.38	1.90	8.72	-22.56

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain G_i (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
1697.43	-19.88	Vertical	-30.70	2.0	8.81	-23.89

WCDMA AND HSUPA MODULATION

A preliminary scan determined the WCDMA modulation as the worst case. The following tables and plots show the results for WCDMA modulation.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

LTE QPSK AND 16QAM MODULATION. Band V. BW = 1.4 MHz, 3 MHz, 5 MHz and 10 MHz.

A preliminary scan determined the QPSK 1.4 MHz bandwidth as the worst case. The configuration of Resource Blocks which is the worst case for conducted power was used.

The following plots show the results for this configuration.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

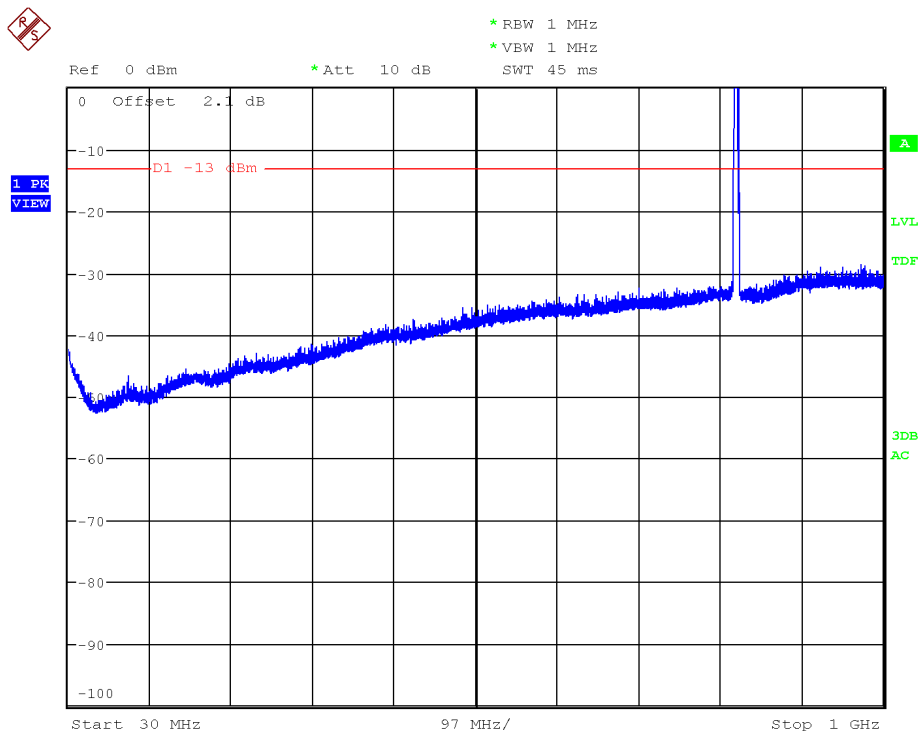
No radiated spurious signals were detected at less than 20 dB respect to the limit.

Verdict: PASS

FREQUENCY RANGE 30 MHz-1000 MHz.

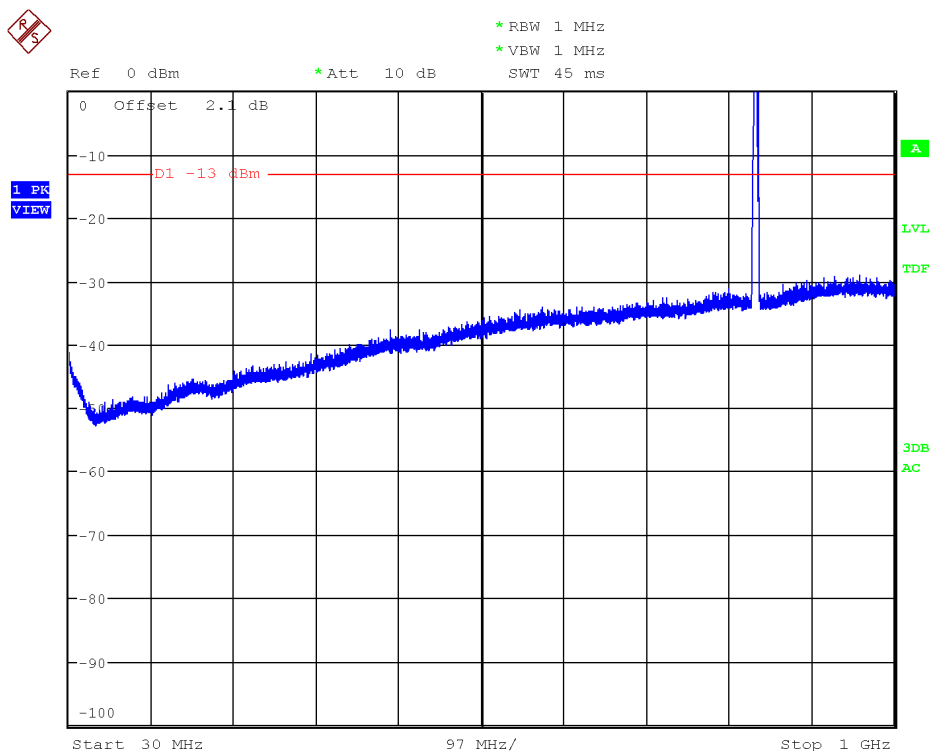
GPRS MODULATION

CHANNEL: LOWEST



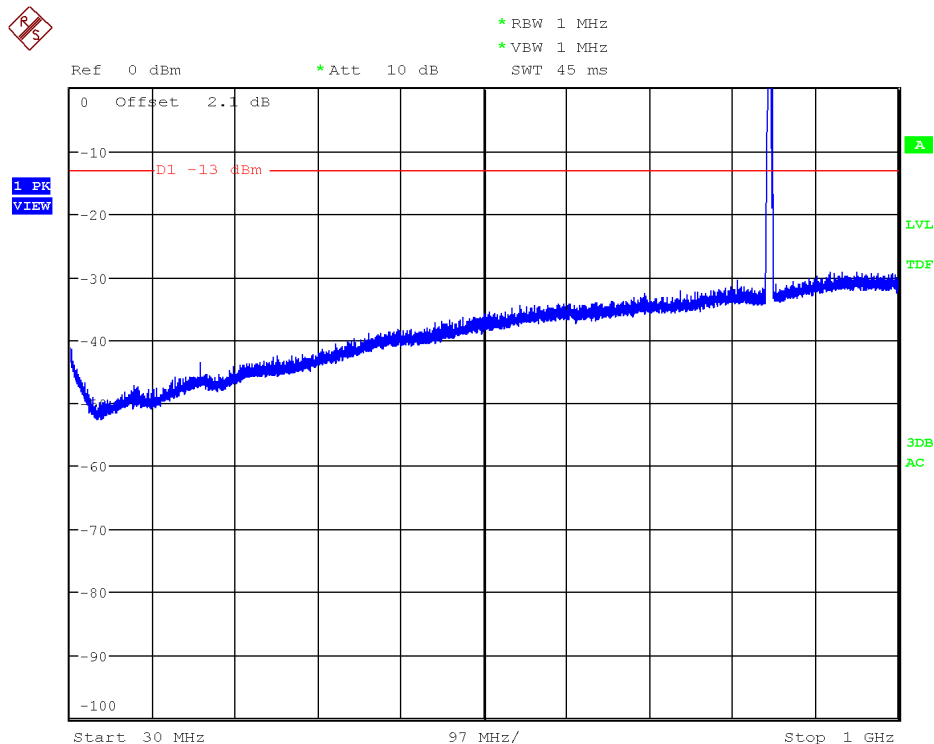
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

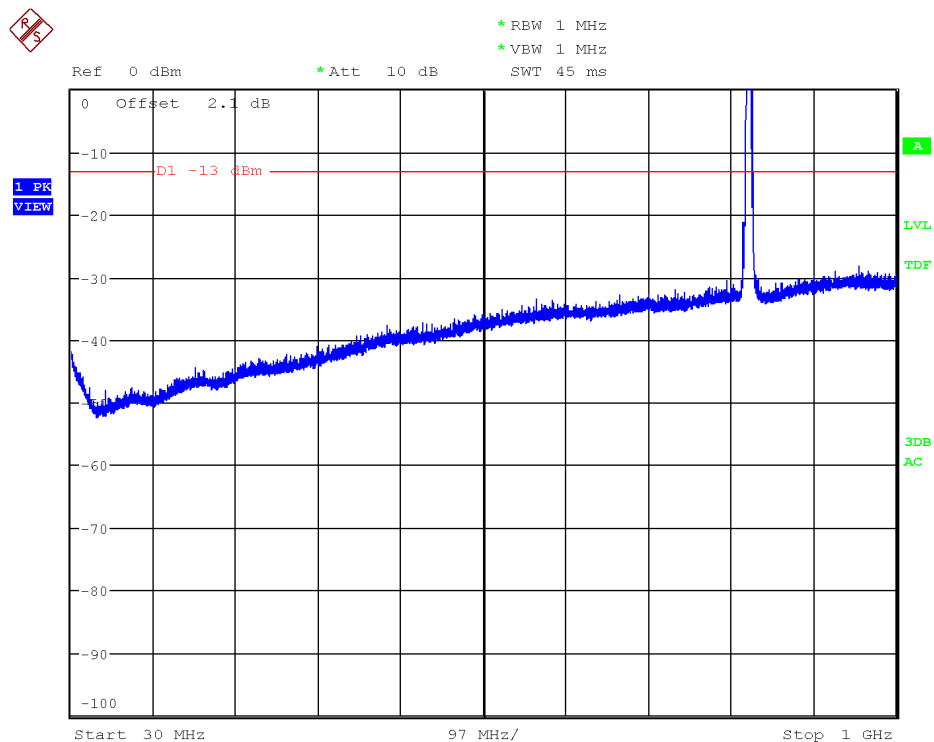
CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

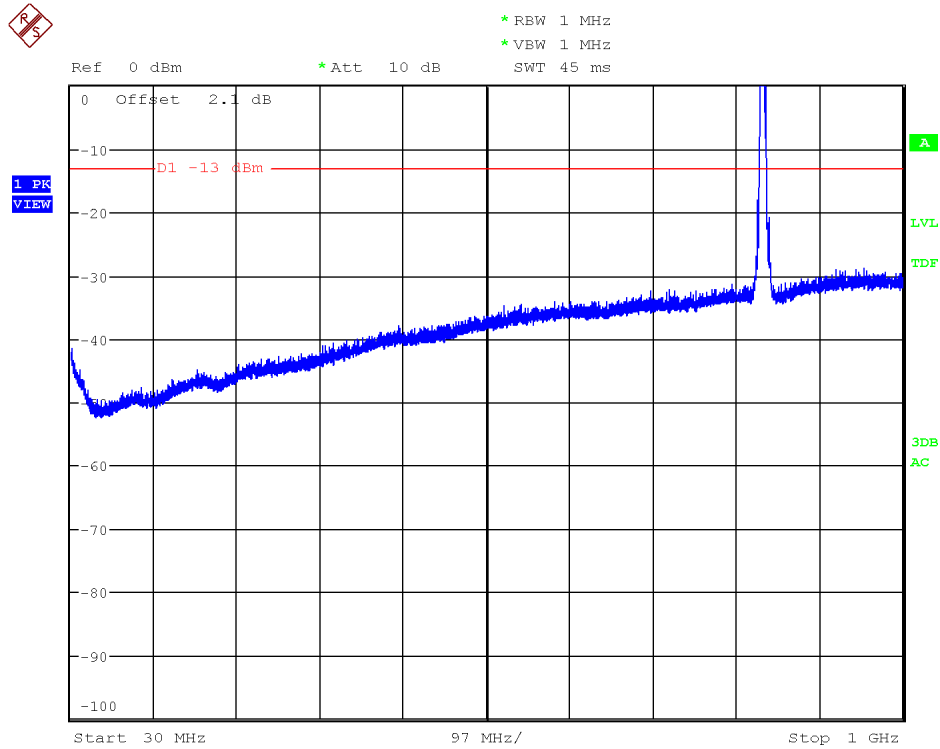
WCDMA MODULATION

CHANNEL: LOWEST



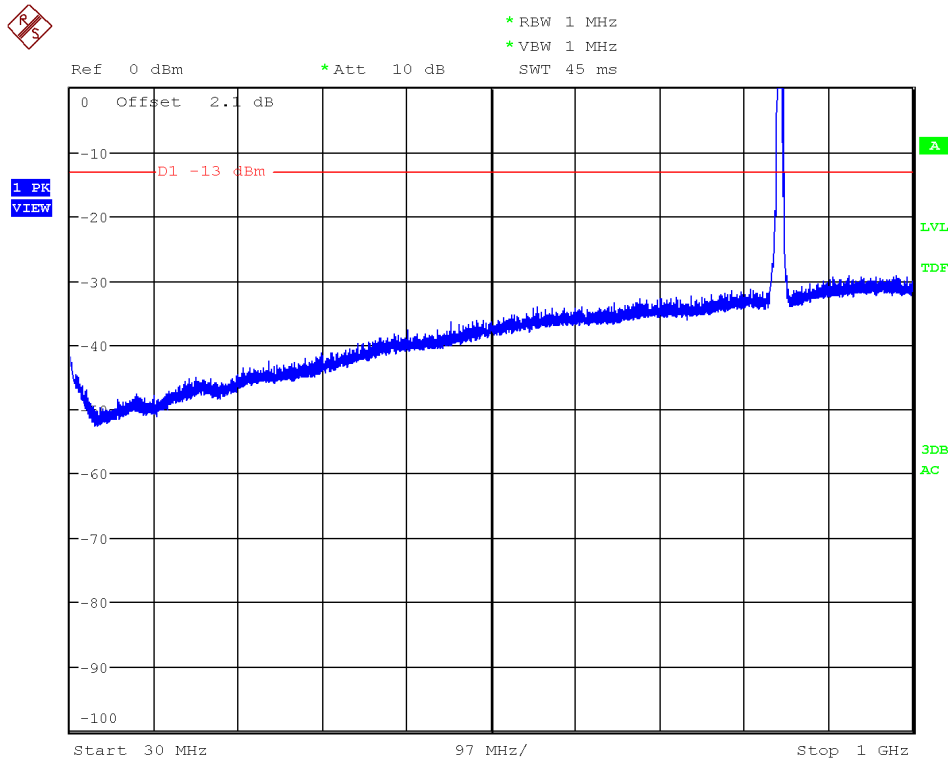
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

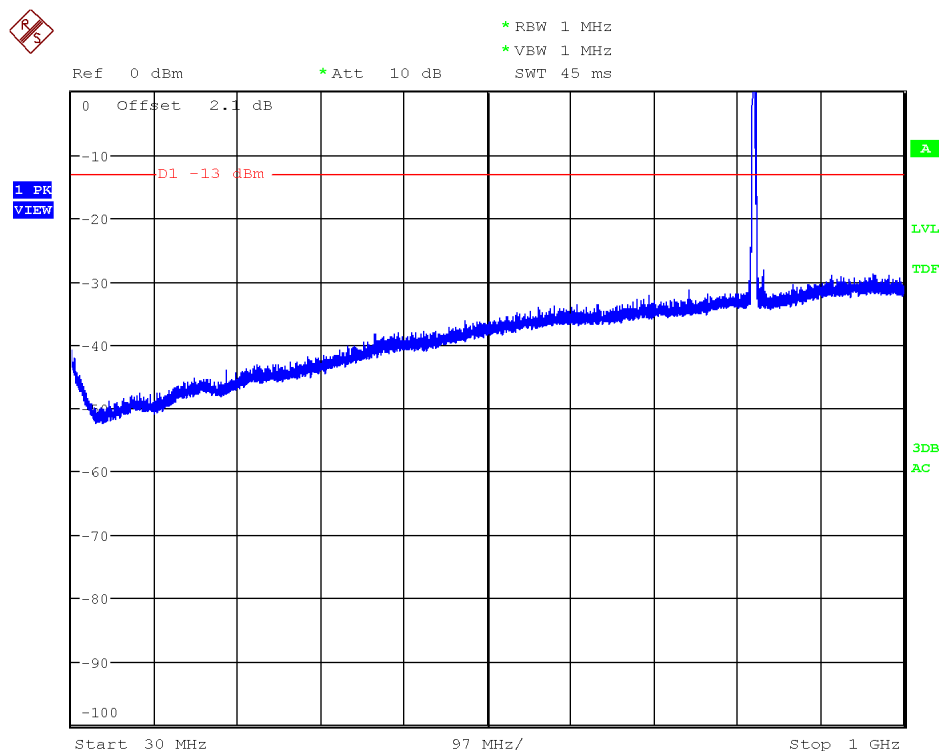
CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

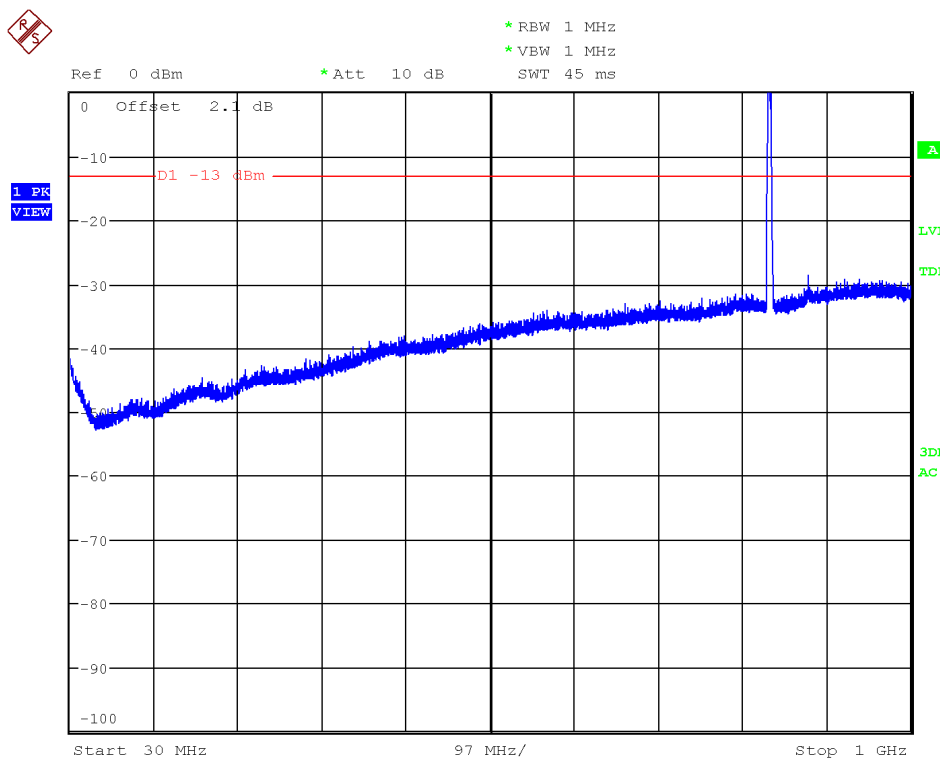
LTE QPSK MODULATION. BW=1.4 MHz. Band V

CHANNEL: LOWEST



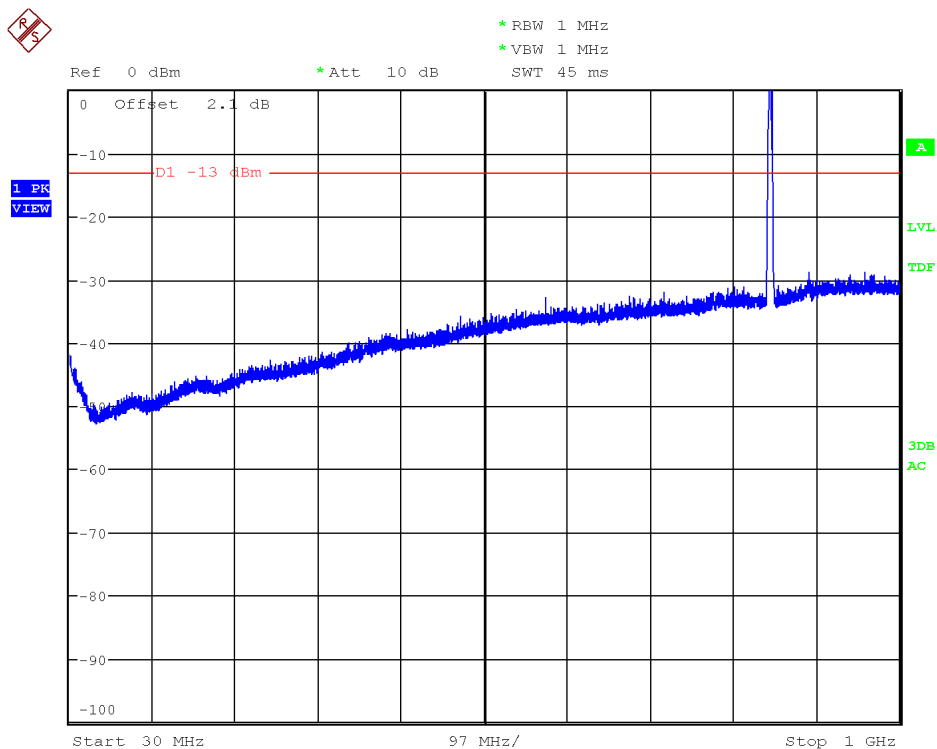
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

CHANNEL: HIGHEST

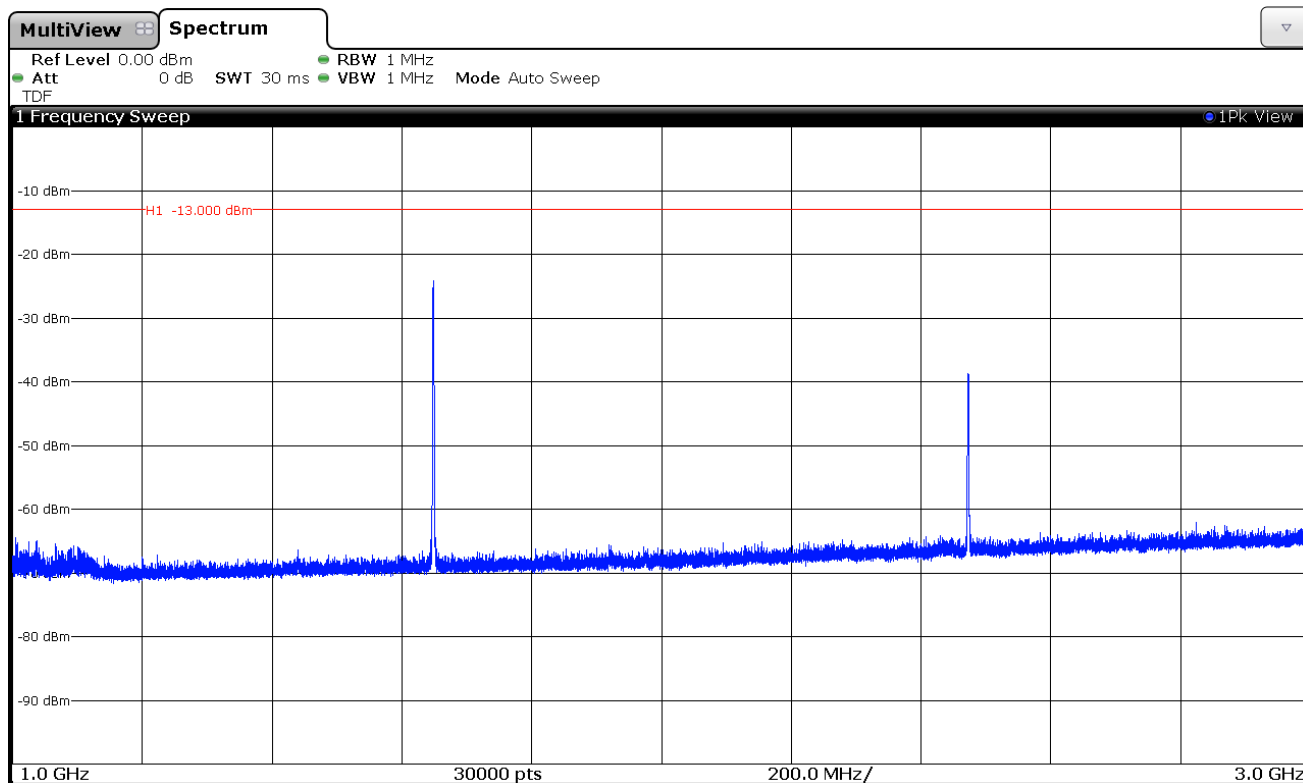


Note: The peak above the limit is the carrier frequency.

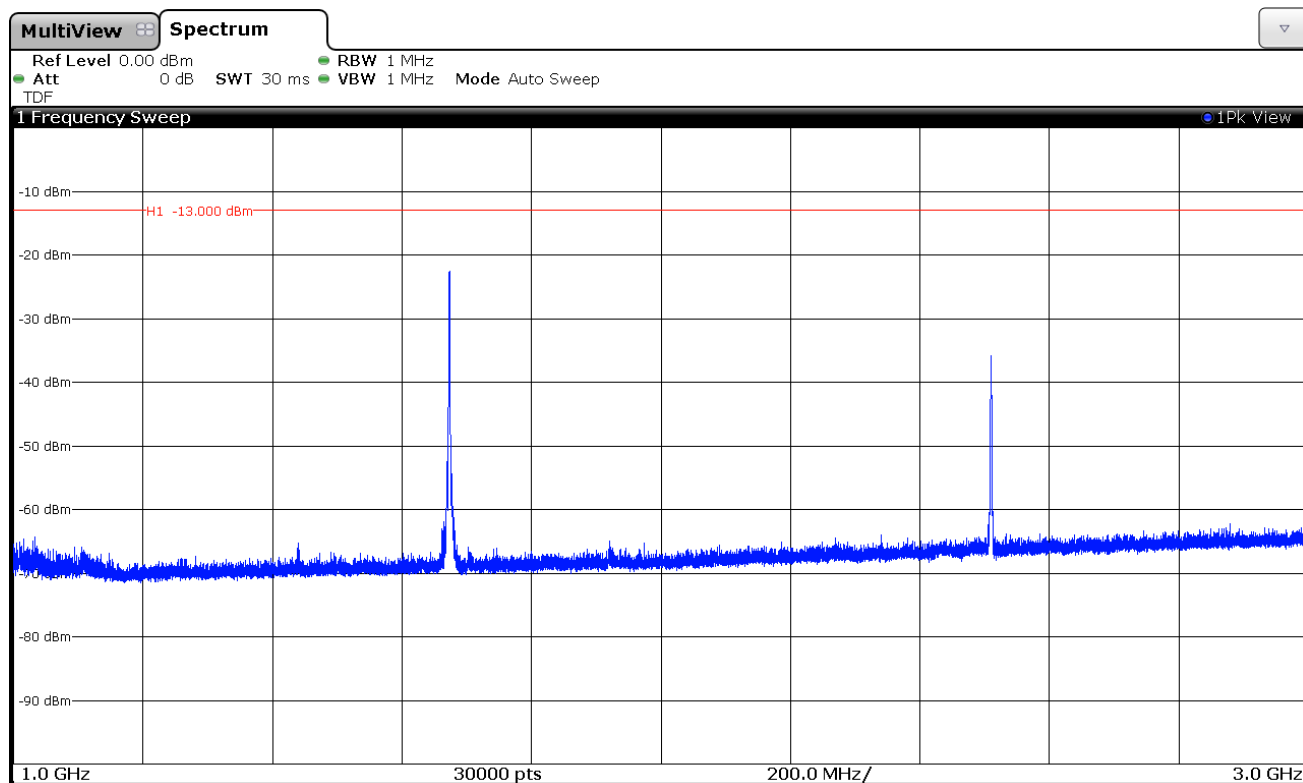
FREQUENCY RANGE 1 GHz to 3 GHz.

GPRS MODULATION

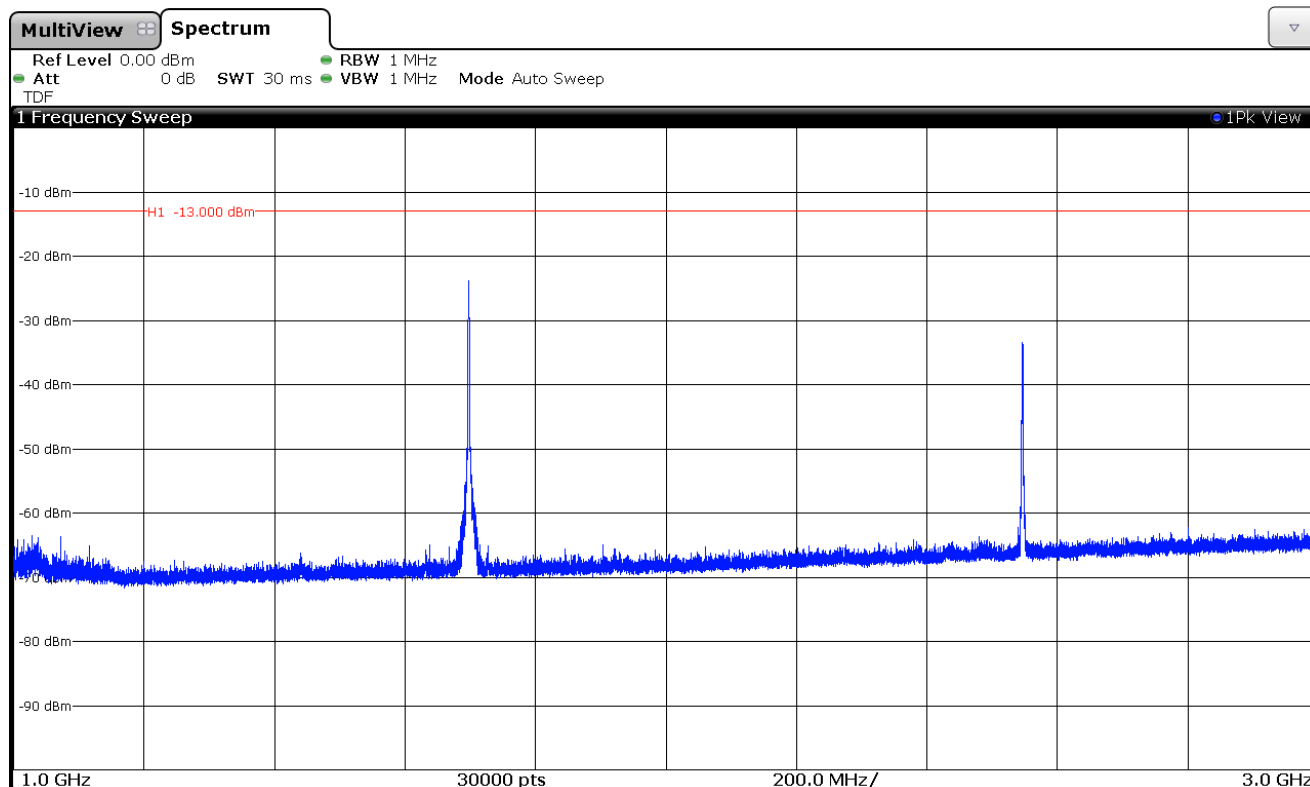
CHANNEL: LOWEST



CHANNEL: MIDDLE

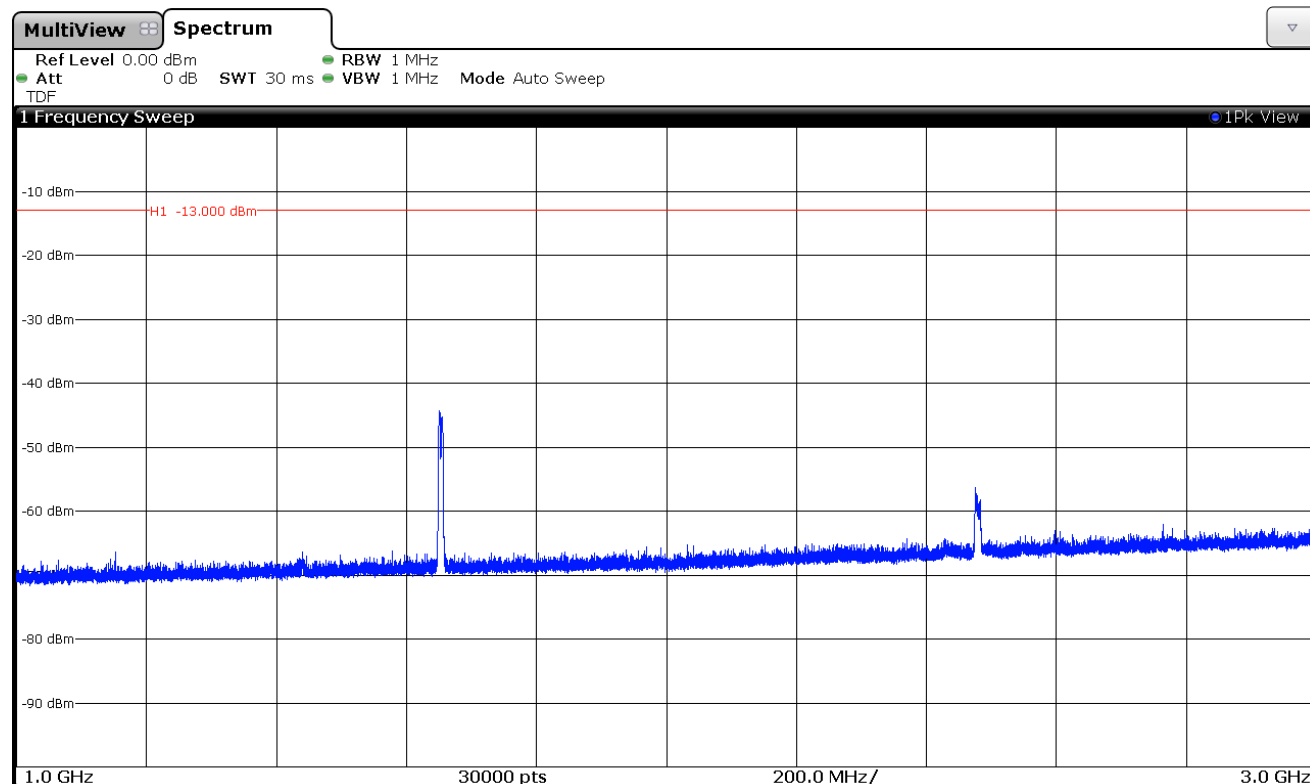


CHANNEL: HIGHEST

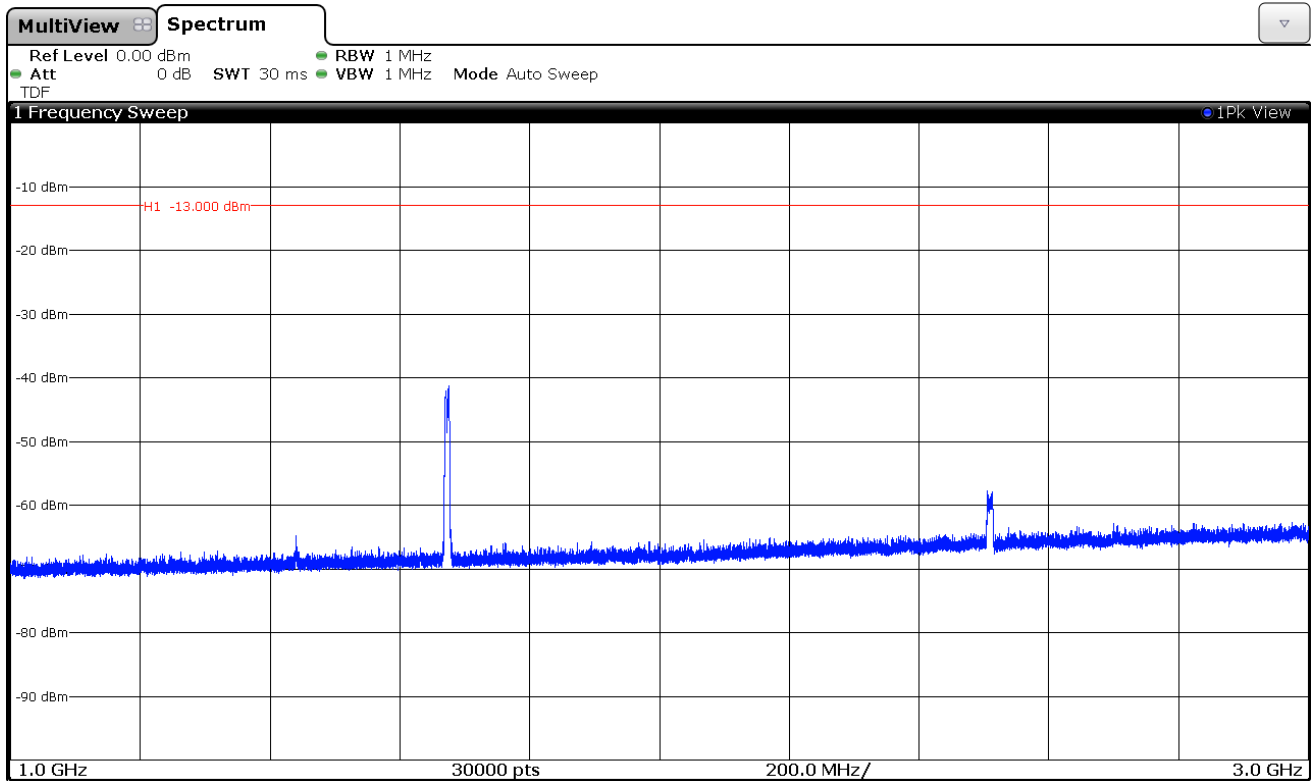


WCDMA MODULATION

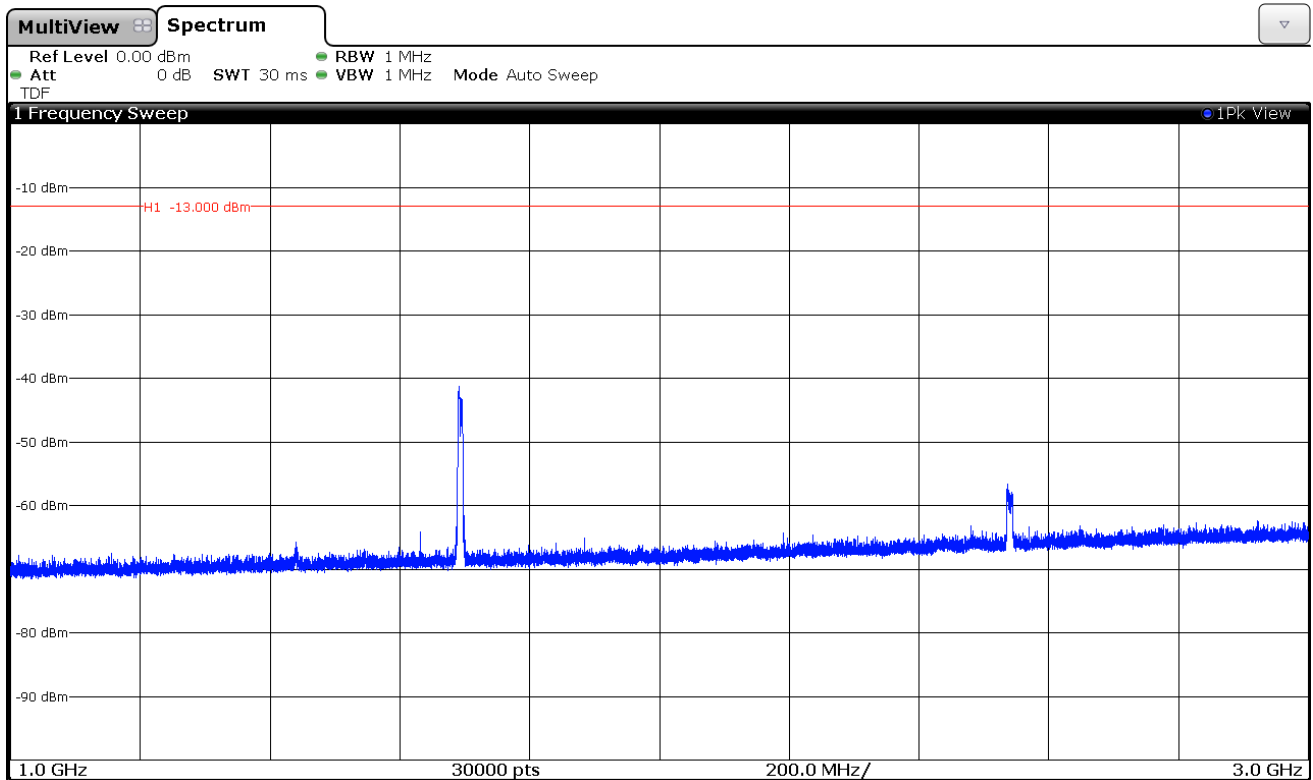
CHANNEL: LOWEST



CHANNEL: MIDDLE

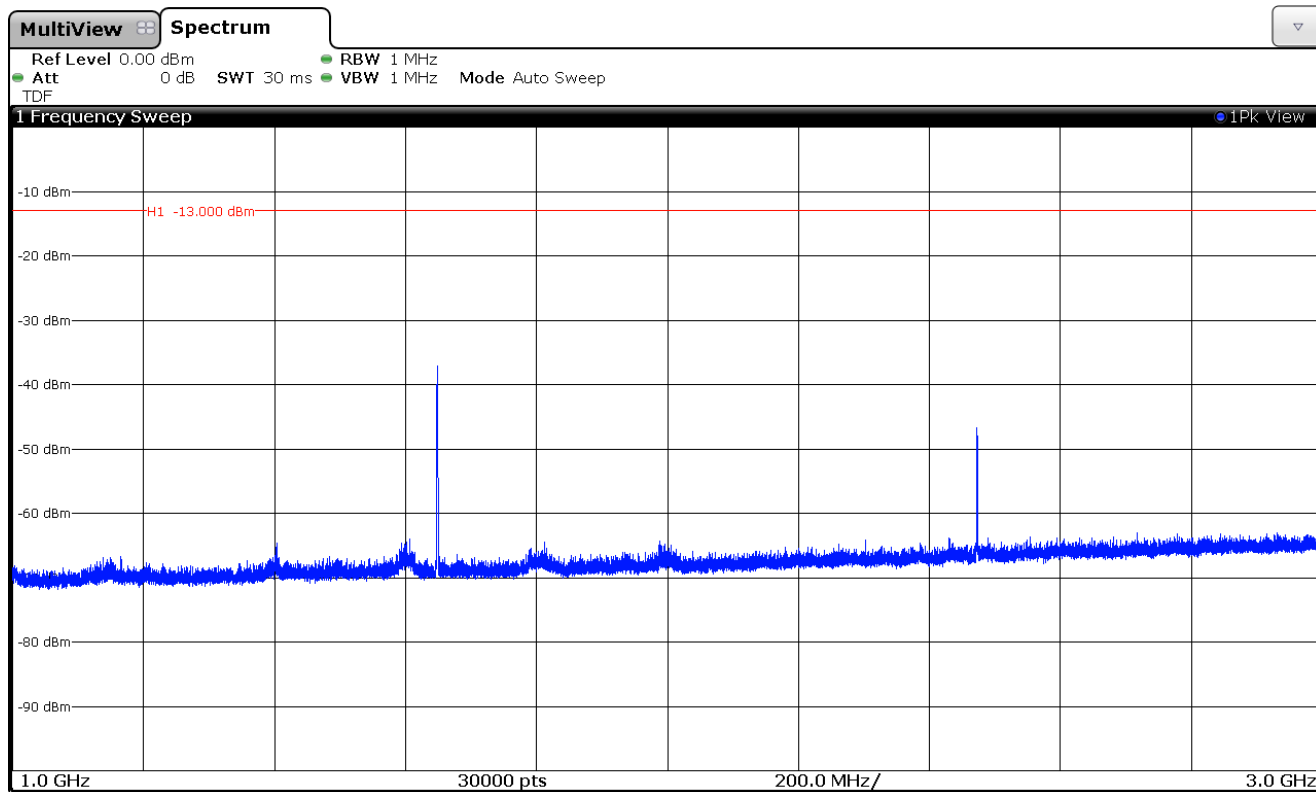


CHANNEL: HIGHEST

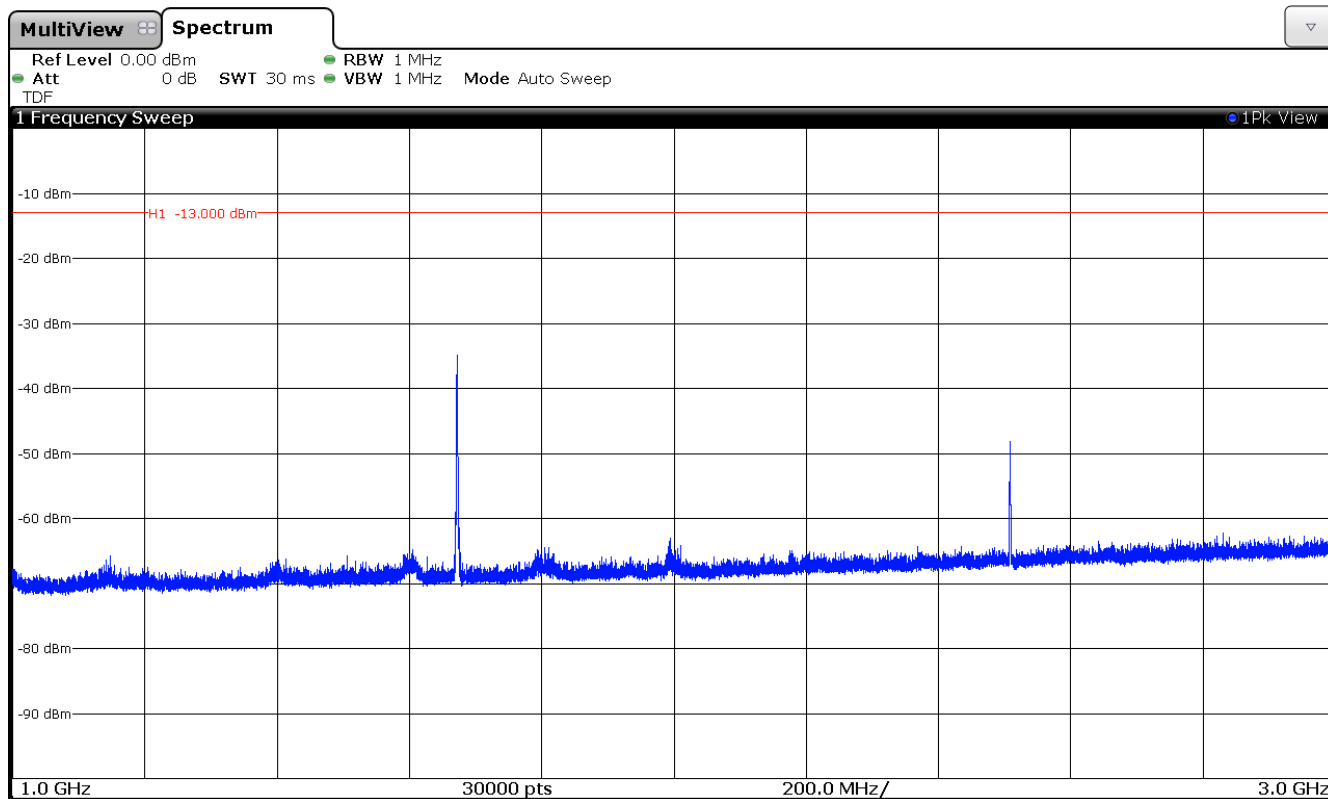


LTE QPSK MODULATION. BW=1.4 MHz. Band V

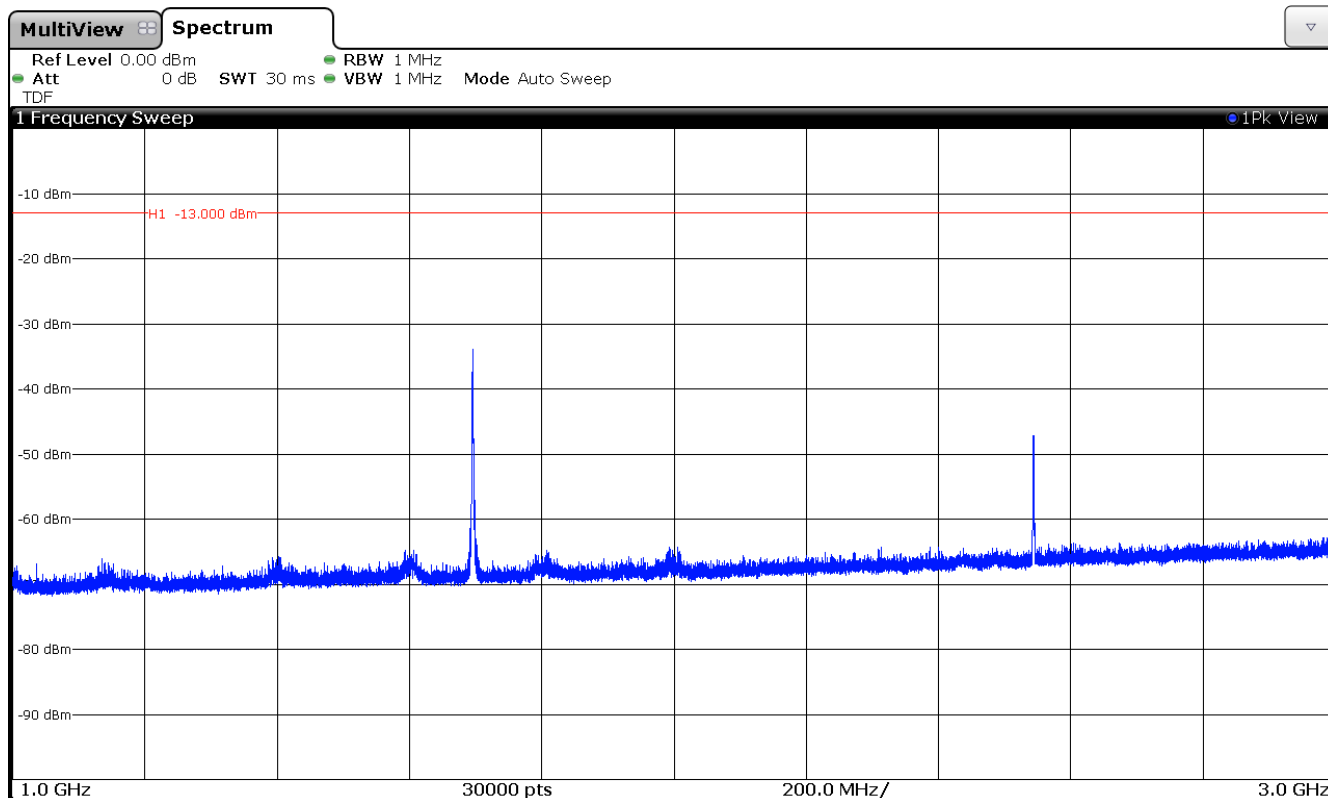
CHANNEL: LOWEST



CHANNEL: MIDDLE



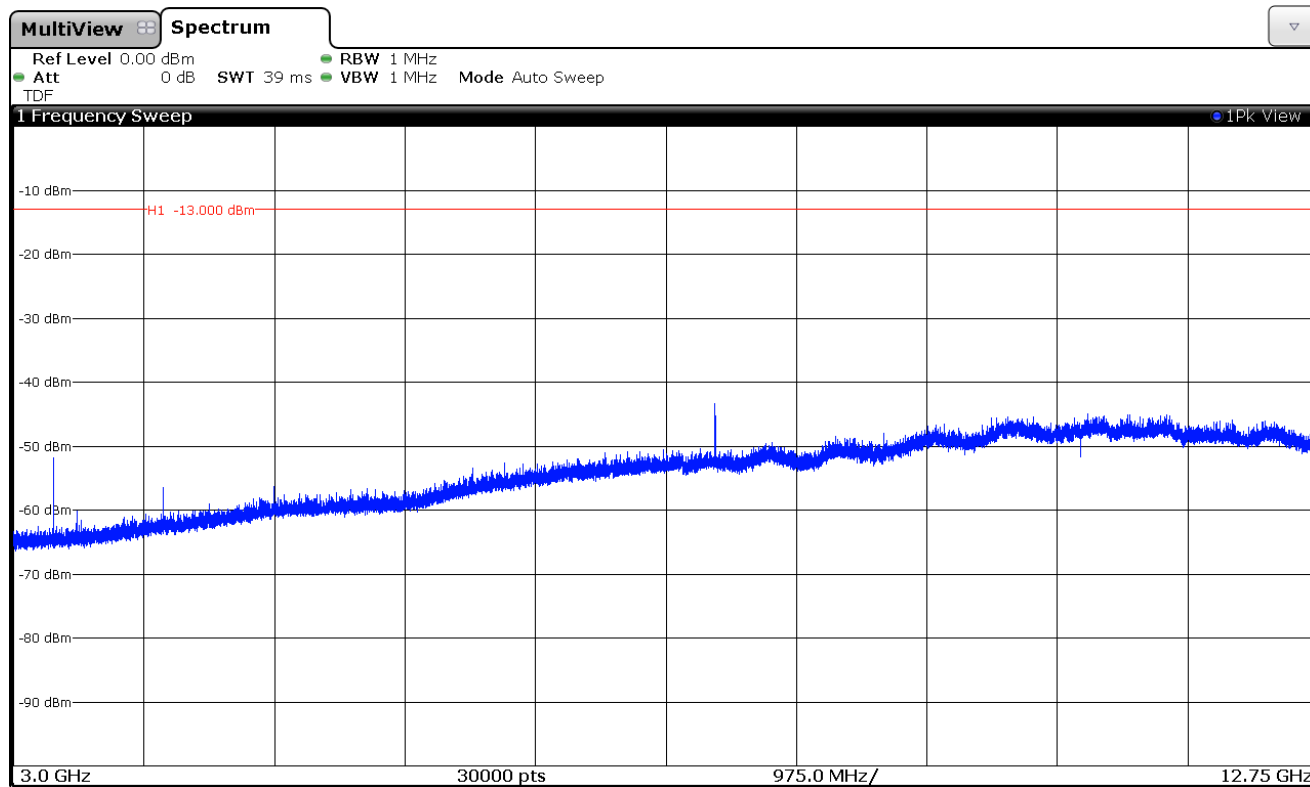
CHANNEL: HIGHEST



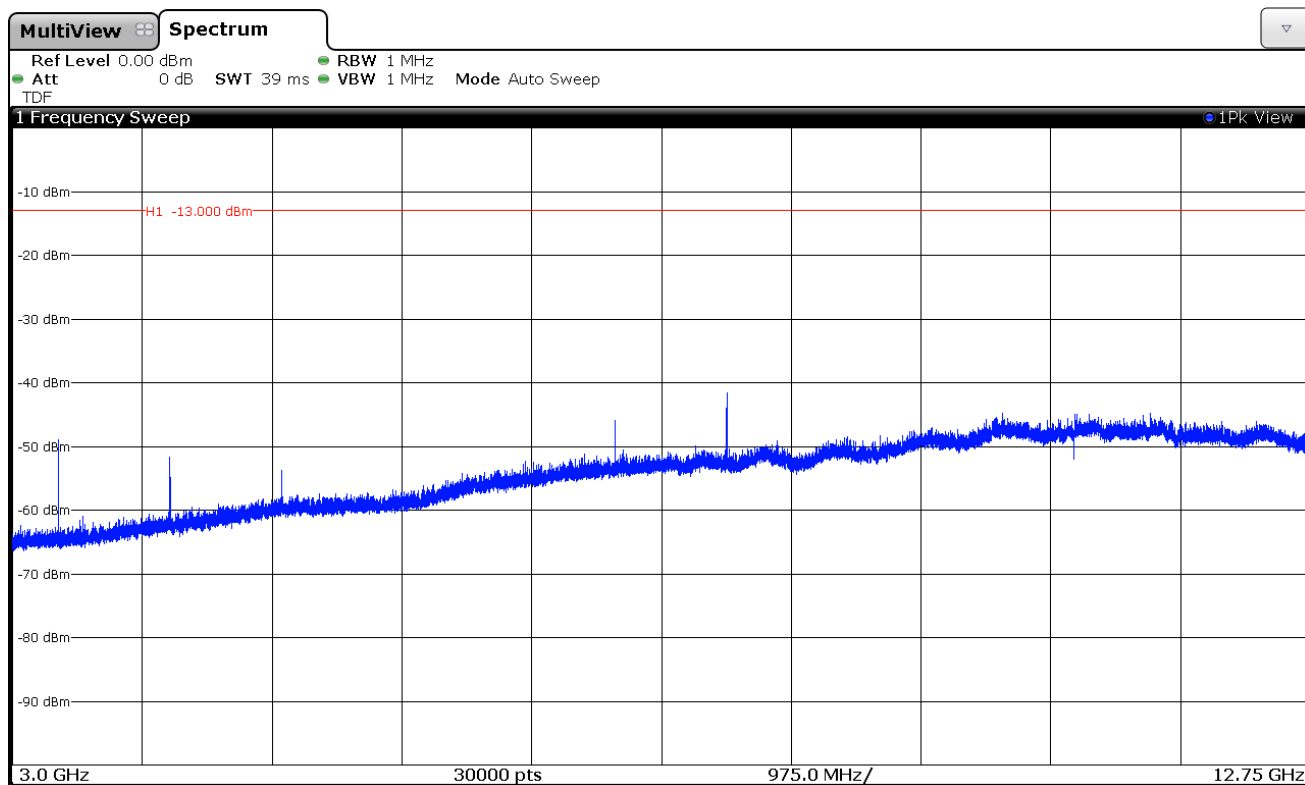
FREQUENCY RANGE 3 GHz to 12.75 GHz.

GPRS MODULATION

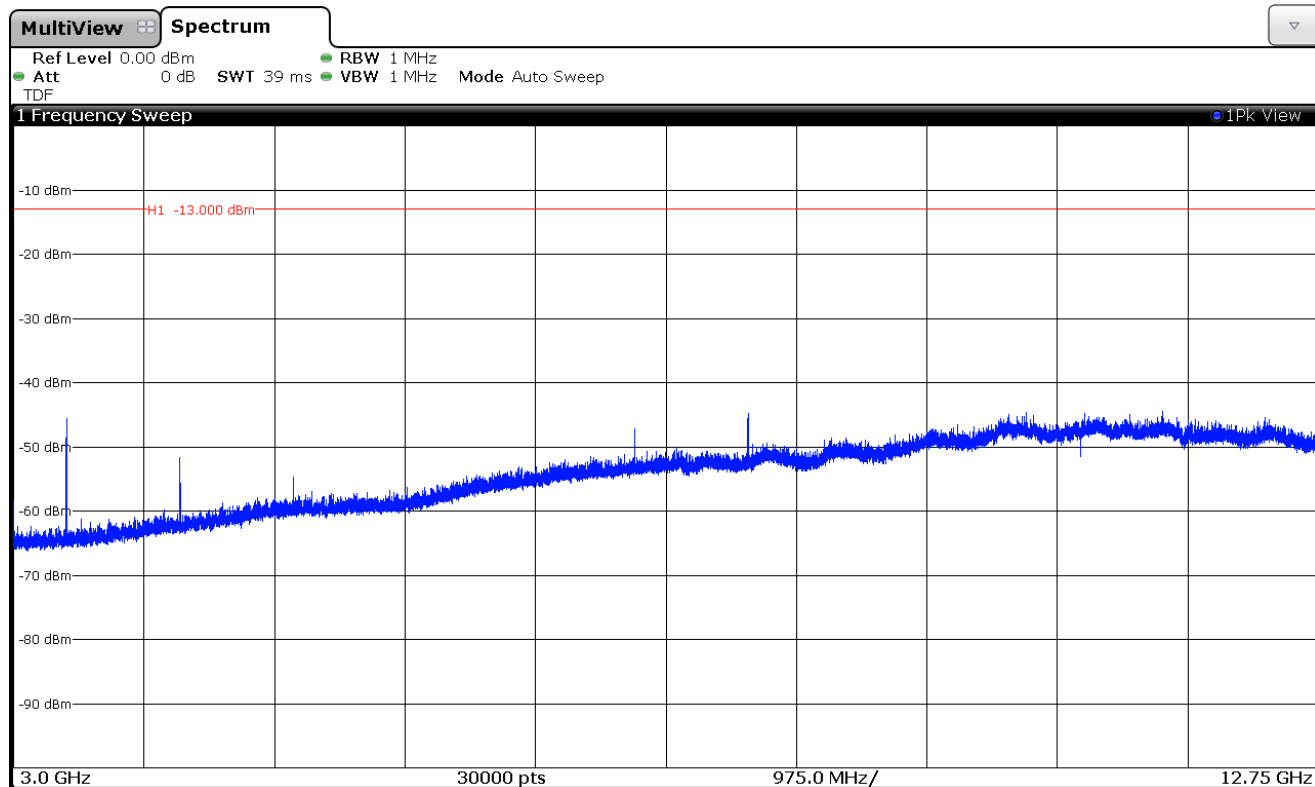
CHANNEL: LOWEST



CHANNEL: MIDDLE

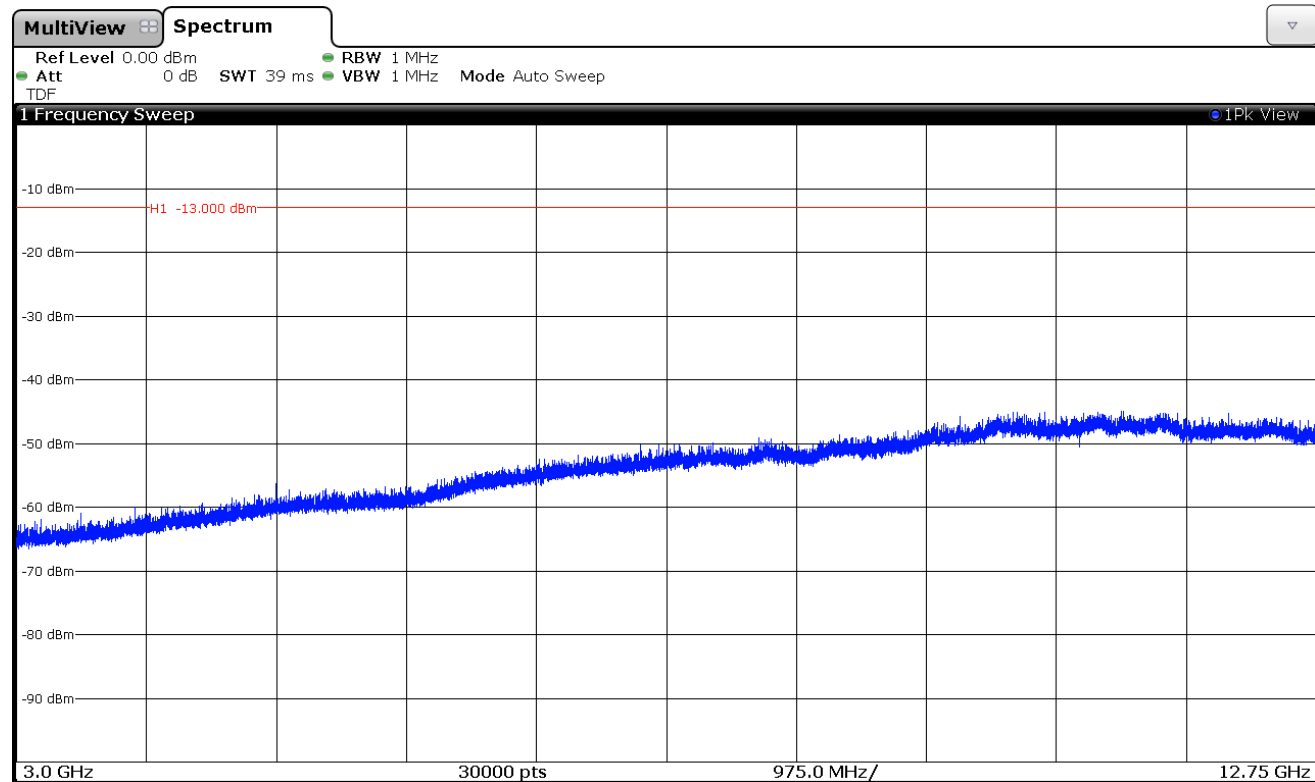


CHANNEL: HIGHEST

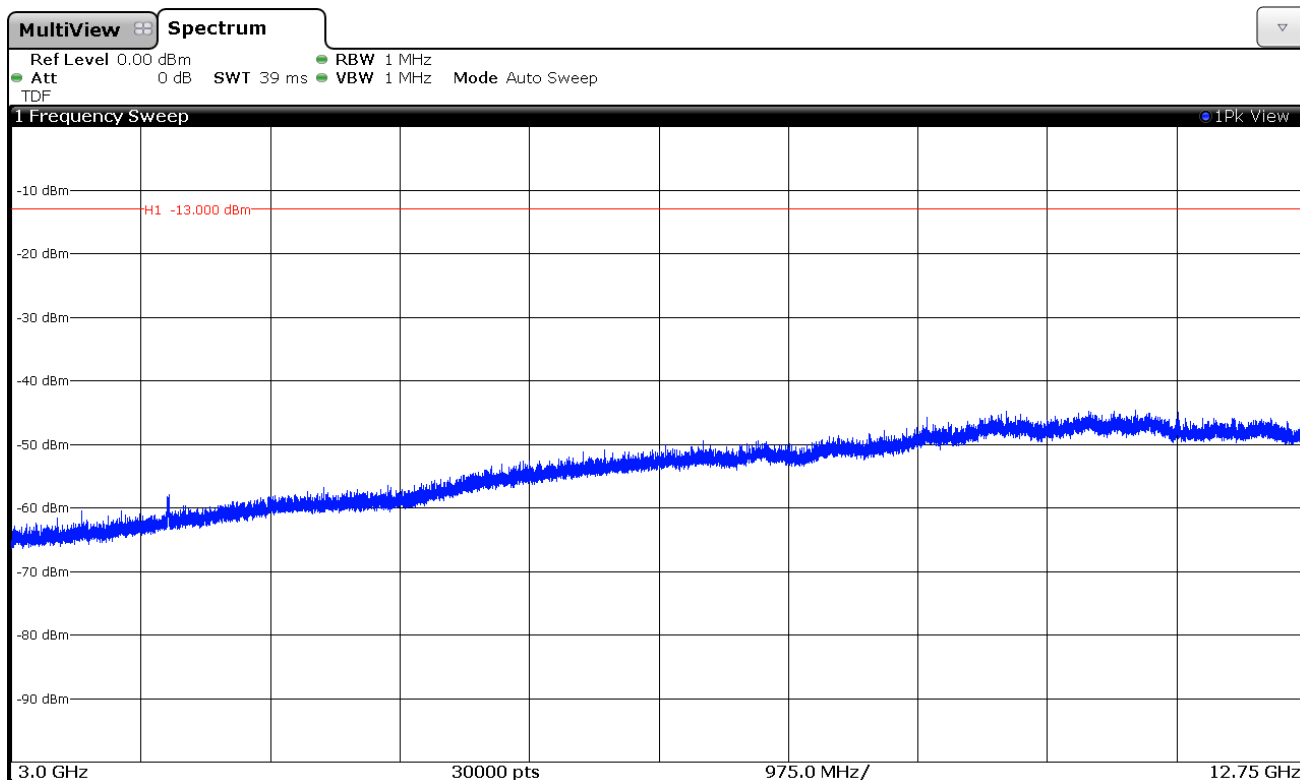


WCDMA MODULATION

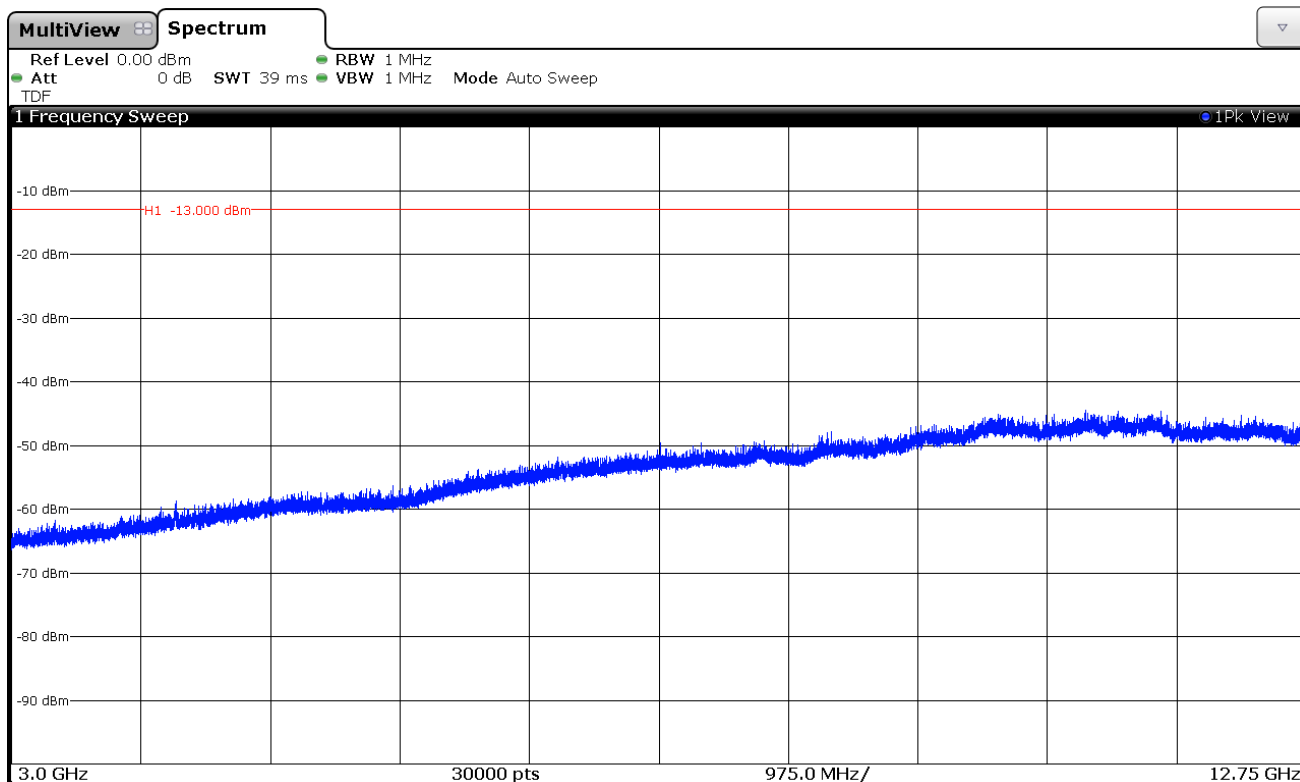
CHANNEL: LOWEST



CHANNEL: MIDDLE

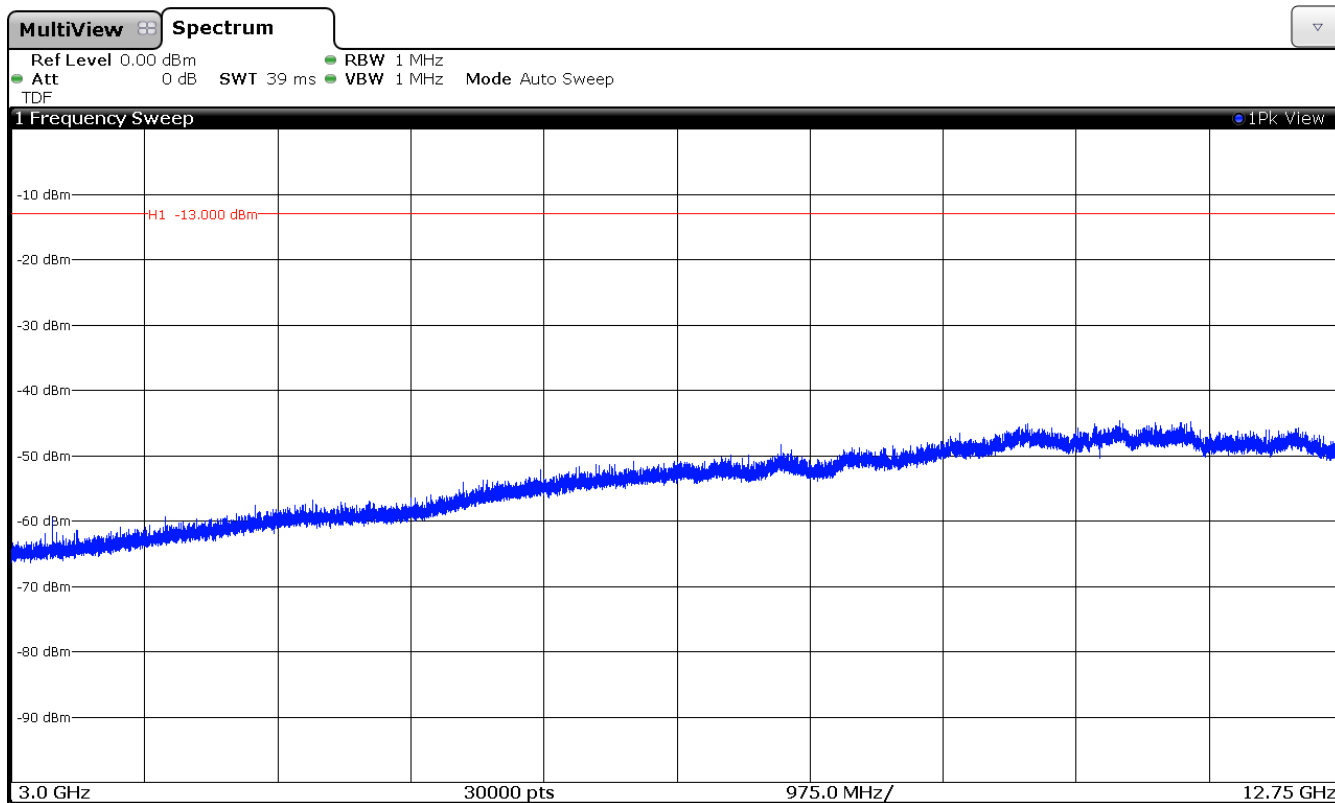


CHANNEL: HIGHEST

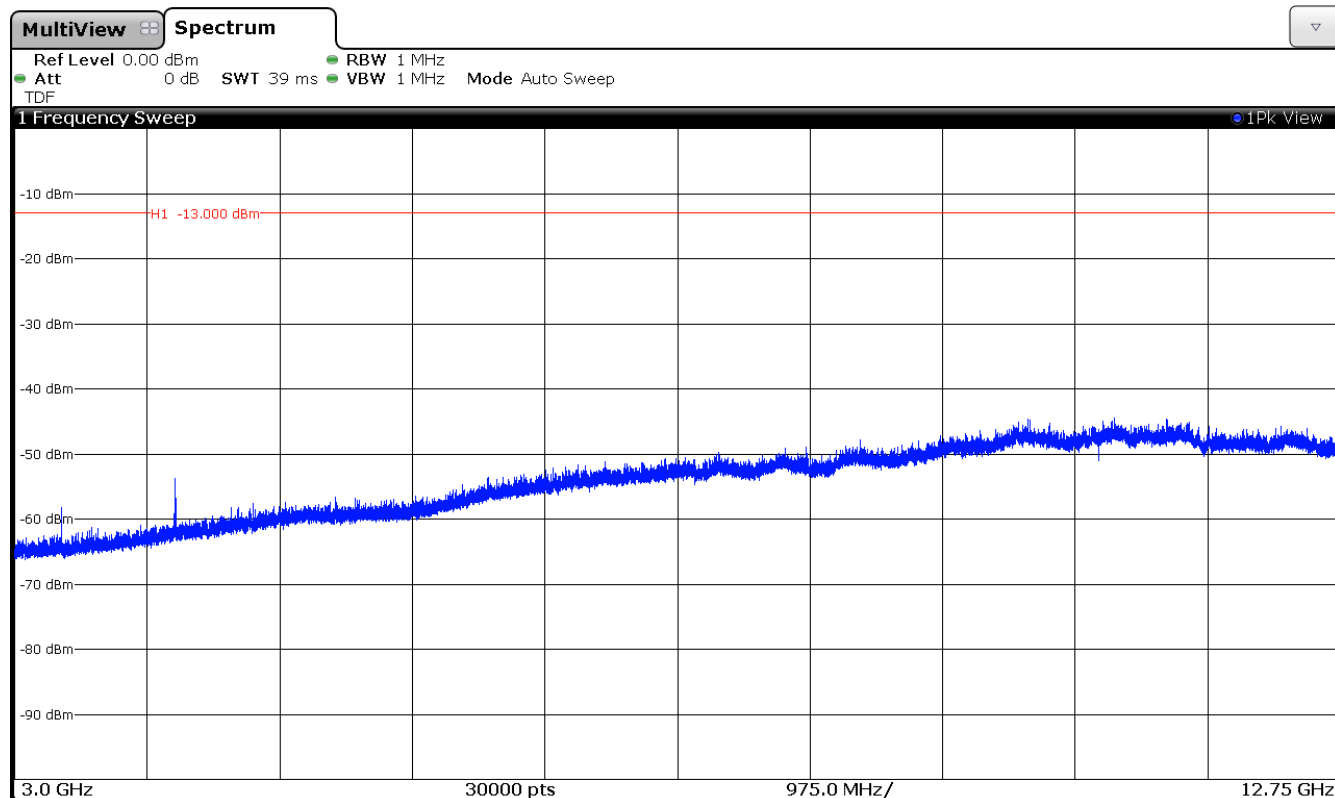


LTE QPSK MODULATION. BW=1.4 MHz. Band V

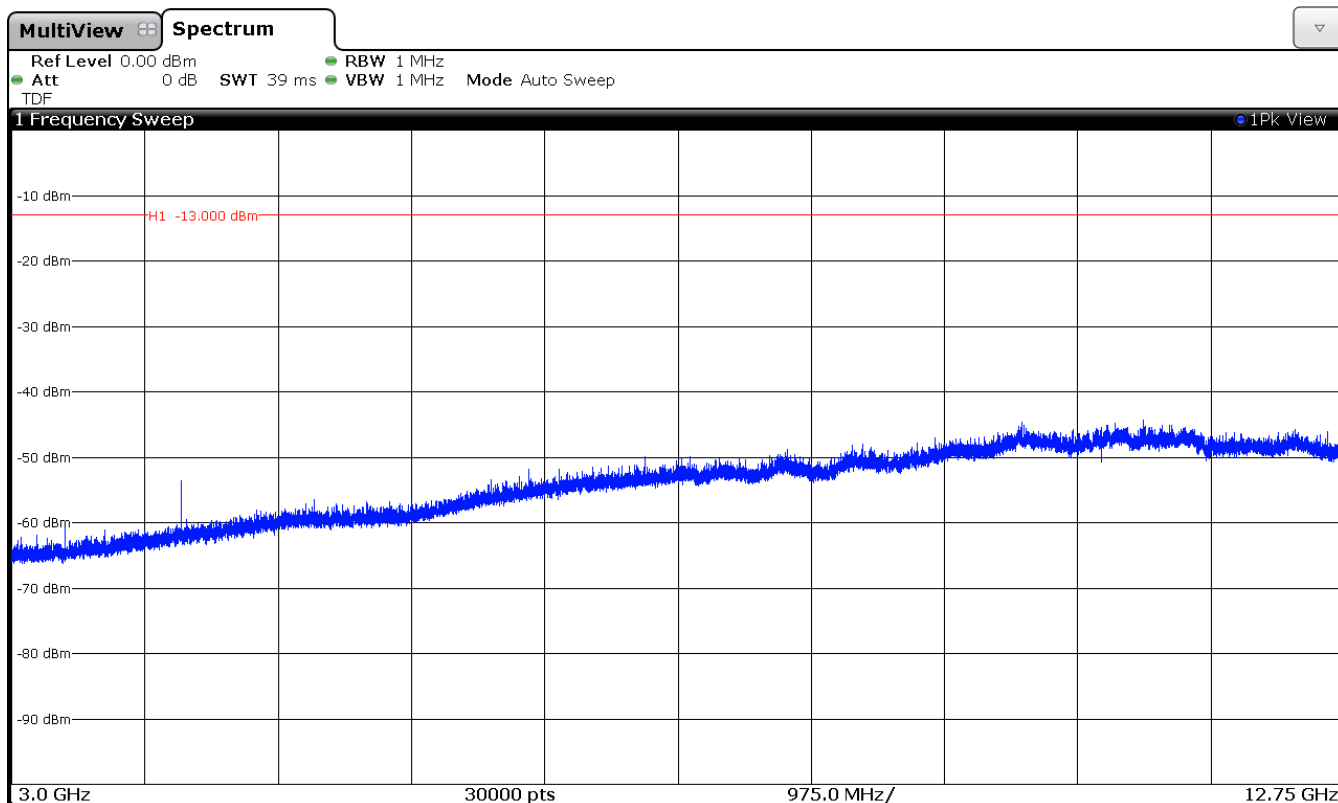
CHANNEL: LOWEST



CHANNEL: MIDDLE



CHANNEL: HIGHEST



Appendix B – Test result for FCC Part 24/IC RSS-133

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TEST RESULTS FOR FCC PART 24 AND IC RSS-133

TEST CONDITIONS

Power supply (V):

$$V_{\text{nom}} = 3.6 \text{ Vdc}$$

$$V_{\text{max}} = \text{N/A}$$

$$V_{\text{min}} = \text{N/A}$$

The subscripts nom, min and max indicate voltage test conditions (nominal, minimum and maximum respectively, as declared by the applicant).

N/A: Not Applicable.

Type of power supply = DC voltage from rechargeable battery.

Type of antenna = External attachable antennae.

TEST FREQUENCIES:

GPRS AND EDGE MODULATION

Lowest channel (512): 1850.2 MHz

Middle channel (662): 1880.2 MHz

Highest channel (810): 1909.8 MHz

WCDMA AND HSUPA MODULATION

Lowest channel (9262): 1852.4 MHz

Middle channel (9400): 1880.0 MHz

Highest channel (9538): 1907.6 MHz

LTE. QPSK AND 16QAM MODULATION (BAND II)

	Channel (Frequency, MHz)					
	BW = 1.4 MHz	BW = 3 MHz	BW = 5 MHz	BW = 10 MHz	BW = 15 MHz	BW = 20 MHz
Lowest	18607 (1850.70)	18615 (1851.50)	18625 (1852.50)	18650 (1855.00)	18675 (1857.50)	18700 (1860.00)
Middle	18900 (1880.00)	18900 (1880.00)	18900 (1880.00)	18900 (1880.00)	18900 (1880.00)	18900 (1880.00)
Highest	19193 (1909.30)	19185 (1908.50)	19175 (1907.50)	19150 (1905.00)	19125 (1902.50)	19100 (1900.00)

Radiated emissions

SPECIFICATION

FCC § 24.238

RSS-133. Clause 6.5.

METHOD

The measurement was performed with the EUT inside an anechoic chamber. The spectrum was scanned from 30 MHz to at least the 10th harmonic of the highest frequency generated within the equipment.

The EUT was placed on a 1.5 meter high non-conductive stand at a 3 meter distance from the measuring antenna for measurements below 1 GHz and at 1 m distance for measurements above 1 GHz.

Detected emissions were maximized at each frequency by rotating the EUT and adjusting the measuring antenna height and polarization. The maximum meter reading was recorded. The radiated emissions were measured with peak detector and 1 MHz bandwidth.

Each detected emission at less than 20 dB below the limit is substituted by the Substitution method, in accordance with the ANSI/TIA/EIA-603-D.

Measurement Limit:

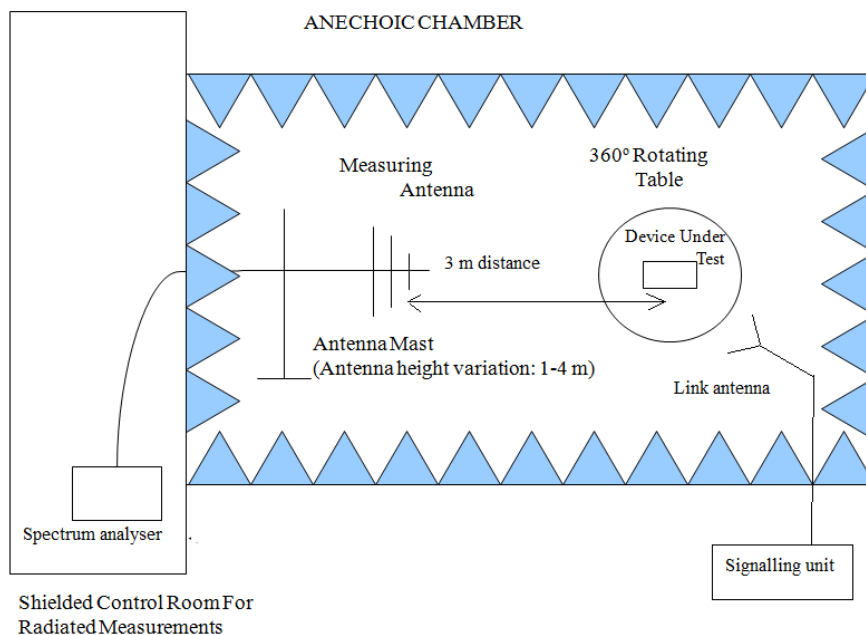
According to specification, the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. P in watts.

At P_o transmitting power, the specified minimum attenuation becomes $43 + 10 \log (P_o)$ and the level in dBm relative P_o becomes:

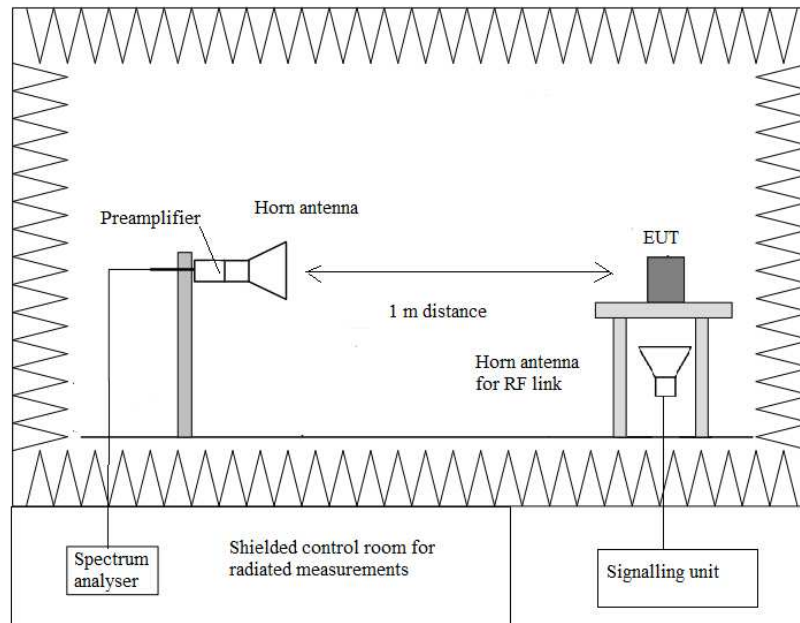
$$P_o \text{ (dBm)} - [43 + 10 \log (P_o \text{ in mwatts}) - 30] = -13 \text{ dBm}$$

TEST SETUP

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



RESULTS

GPRS AND EDGE MODULATION

A preliminary scan determined the GPRS modulation as the worst case. The following plots show the results for GPRS modulation.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

WCDMA AND HSUPA MODULATION

A preliminary scan determined the WCDMA modulation as the worst case. The following tables and plots show the results for WCDMA modulation.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

No spurious signals were found in all the range.

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
3761.75	-30.98	Vertical	-37.40	2.70	11.90	-28.20

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

LTE QPSK AND 16QAM MODULATION. Band II. BW = 1.4 MHz, 3 MHz, 5 MHz, 10 MHz 15 MHz and 20 MHz.

A preliminary scan determined the QPSK 20MHz bandwidth as the worst case. The configuration of Resource Blocks which is the worst case for conducted power was used.

The following tables and plots show the results for this configuration.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
3720.25	-34.59	Vertical	-41.14	2.70	11.89	-31.95

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
3760.25	-30.12	Vertical	-36.54	2.70	11.90	-27.34
5640.25	-41.55	vertical	-42.41	3.40	12.87	-32.94

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

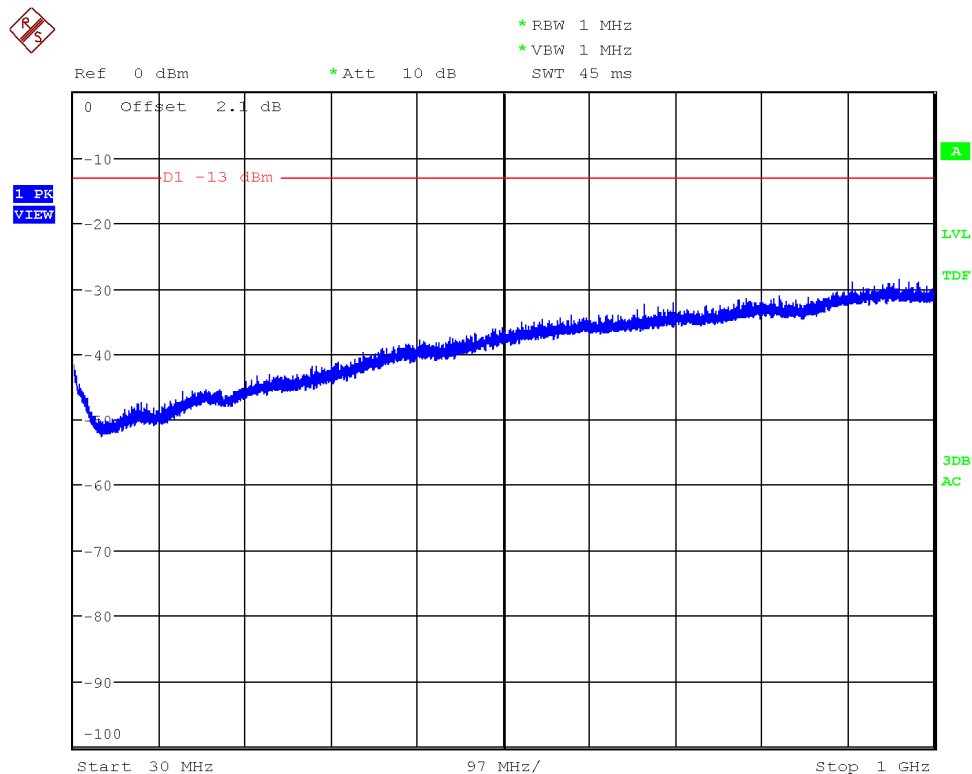
Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
3800.25	-33.75	Vertical	-40.06	2.70	11.92	-30.84

Verdict: PASS

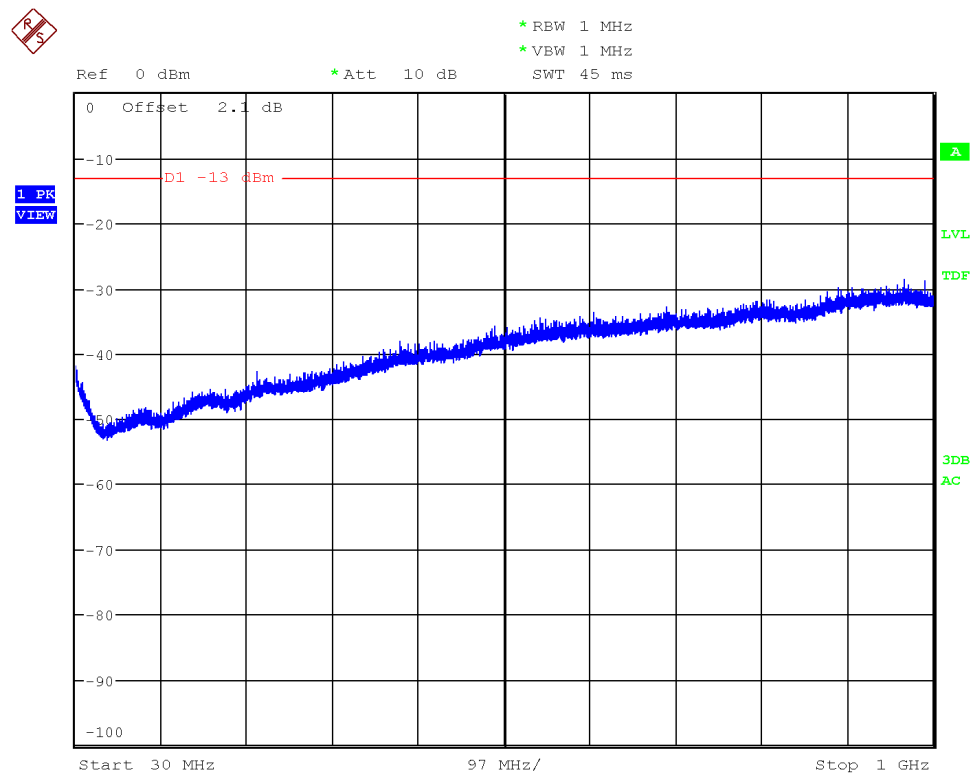
FREQUENCY RANGE 30 MHz-1000 MHz.

GPRS MODULATION



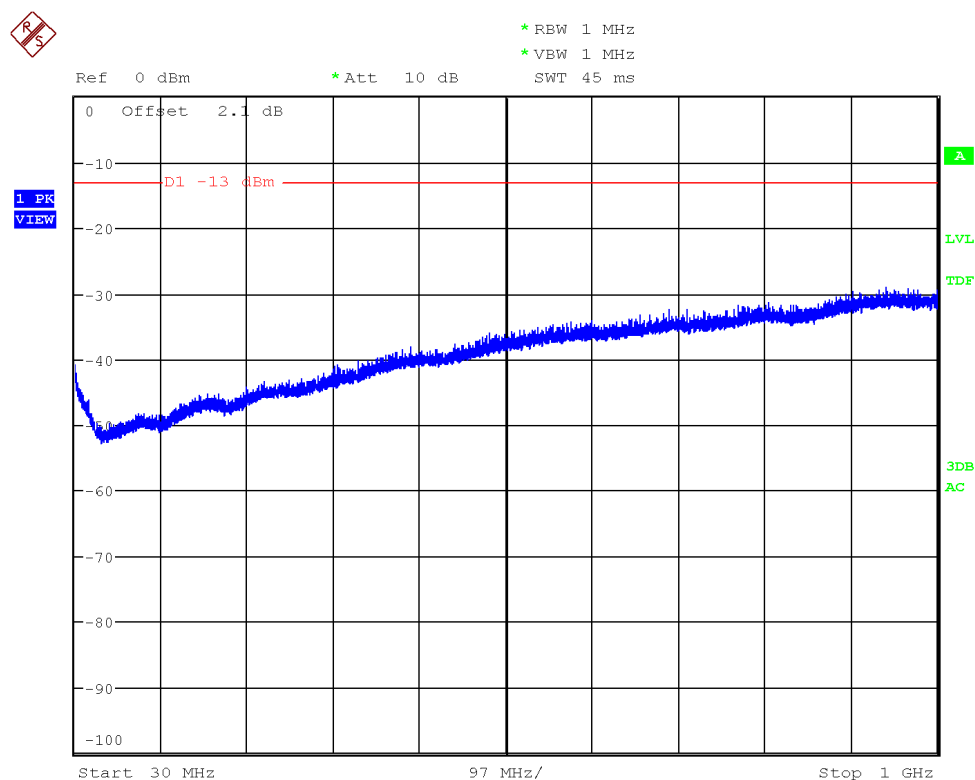
(This plot is valid for all three channels)

WCDMA MODULATION



(This plot is valid for all three channels)

LTE QPSK MODULATION. BW=20 MHz. Band II

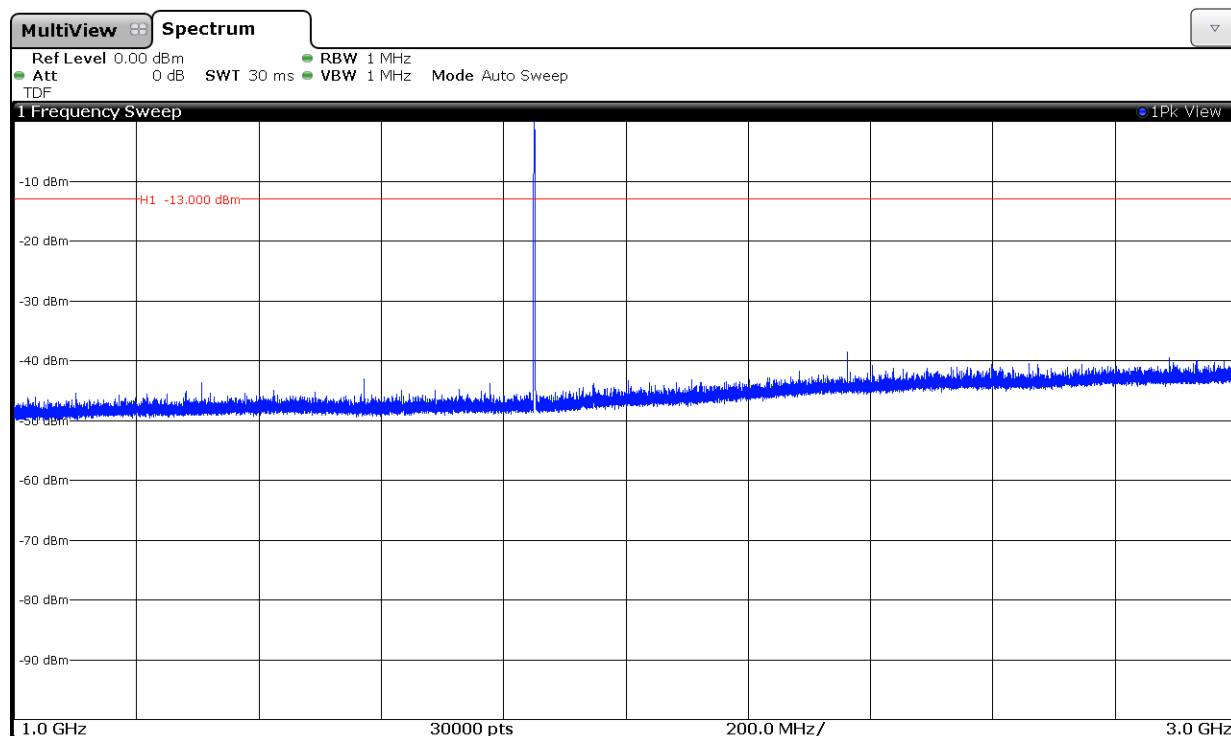


(This plot is valid for all three channels)

FREQUENCY RANGE 1 GHz to 3 GHz.

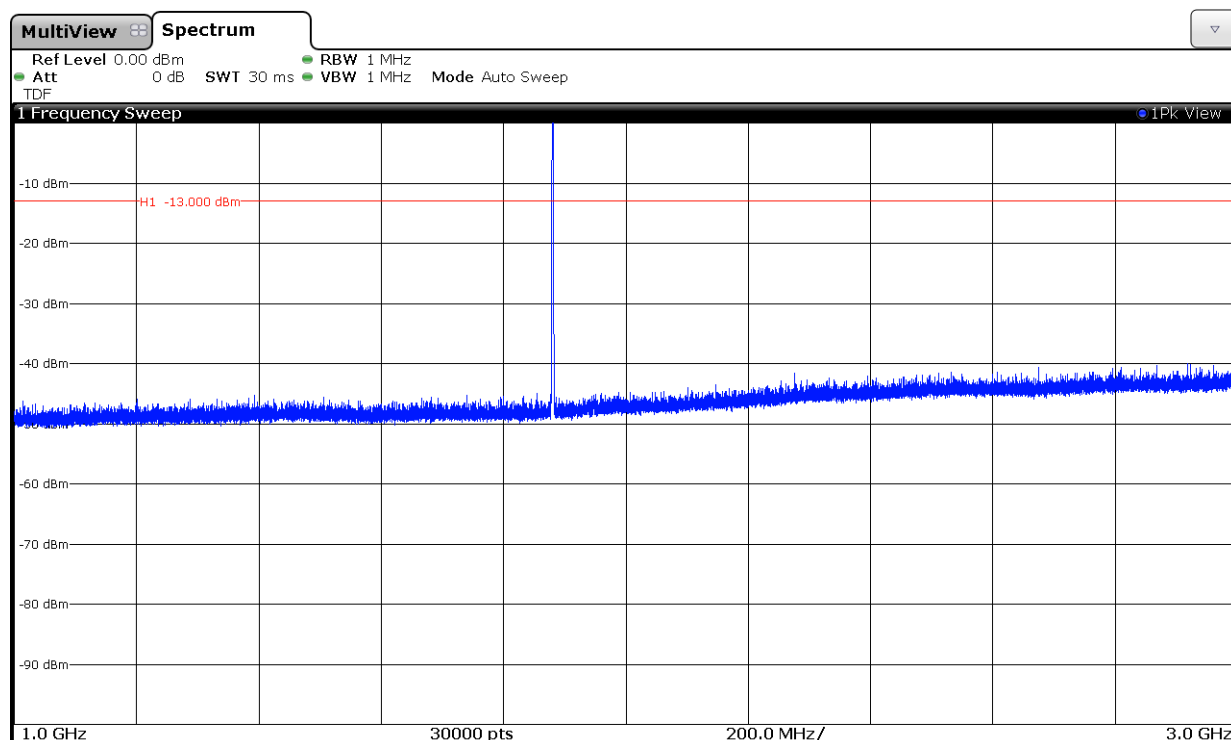
GPRS MODULATION

CHANNEL: LOWEST



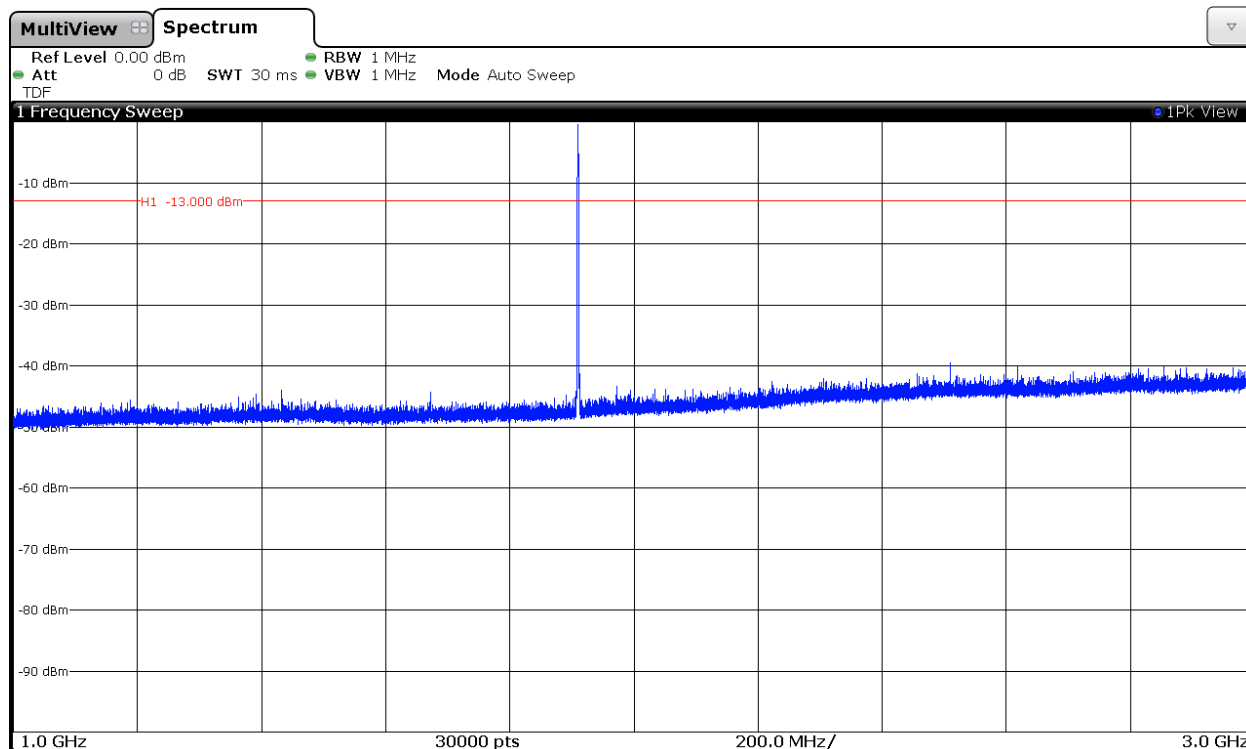
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

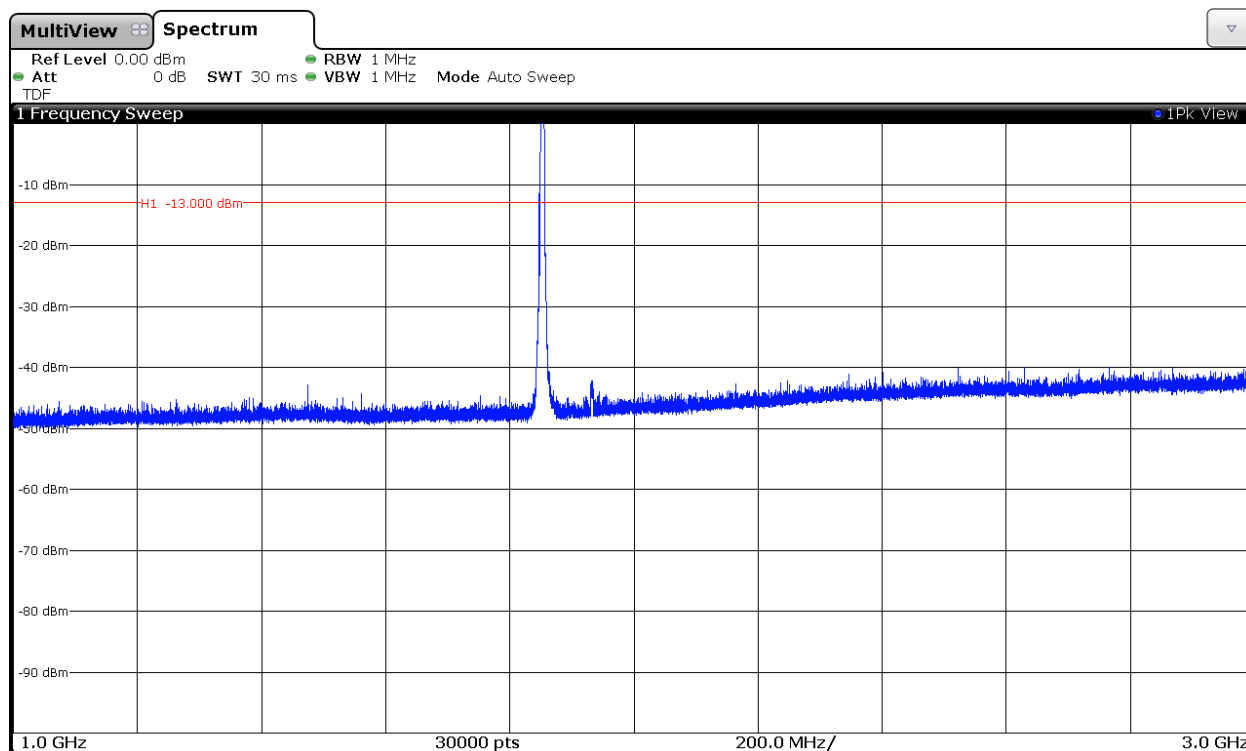
CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

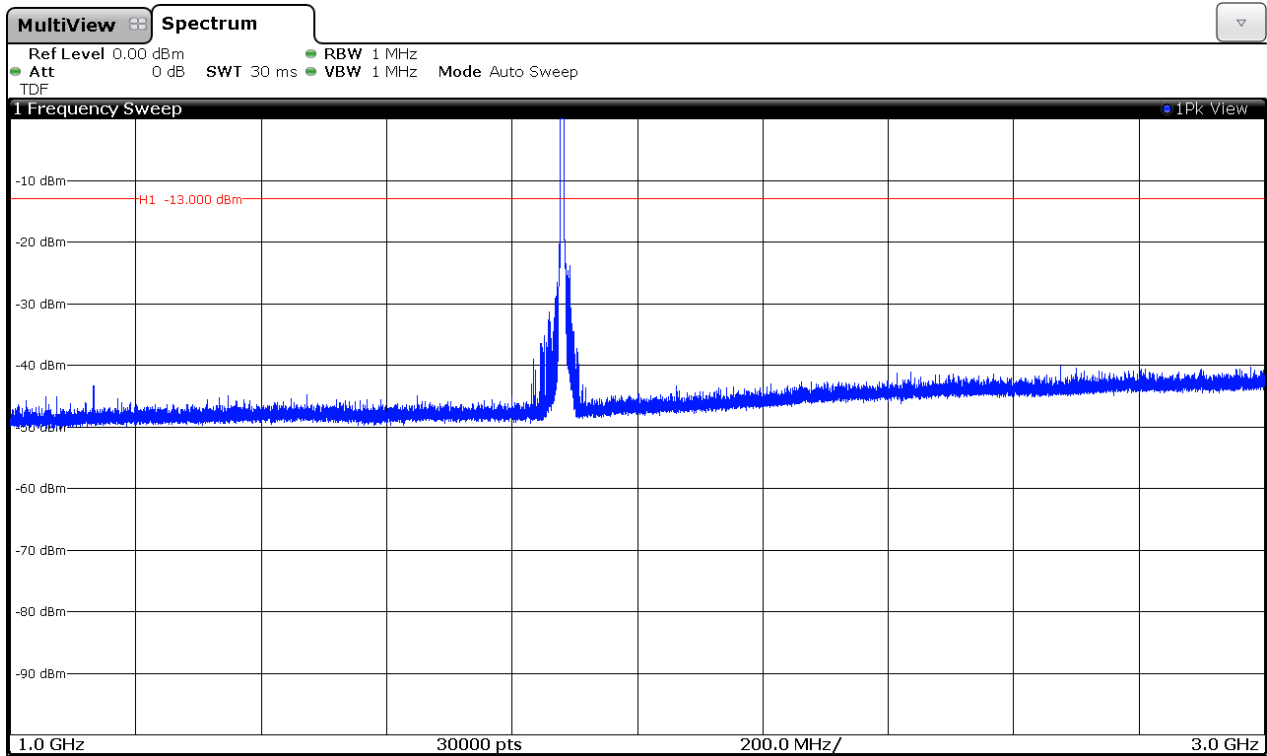
WCDMA MODULATION

CHANNEL: LOWEST



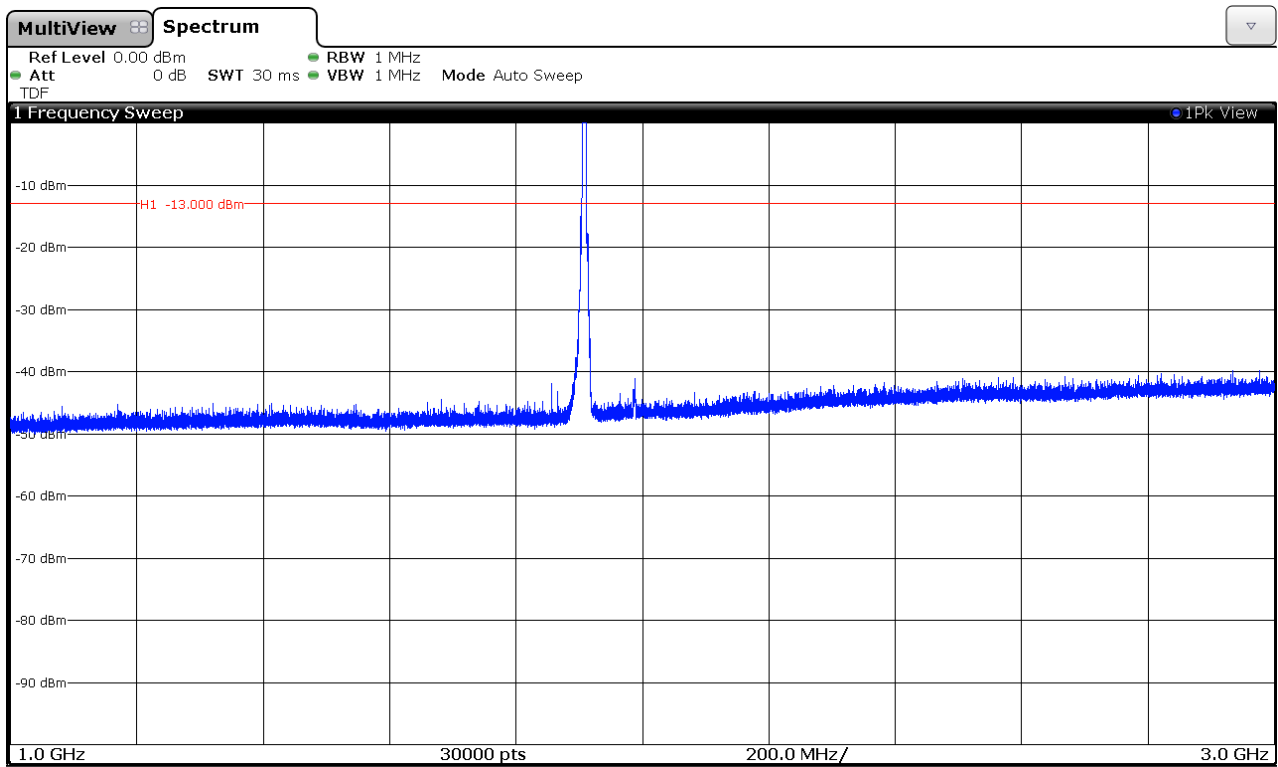
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

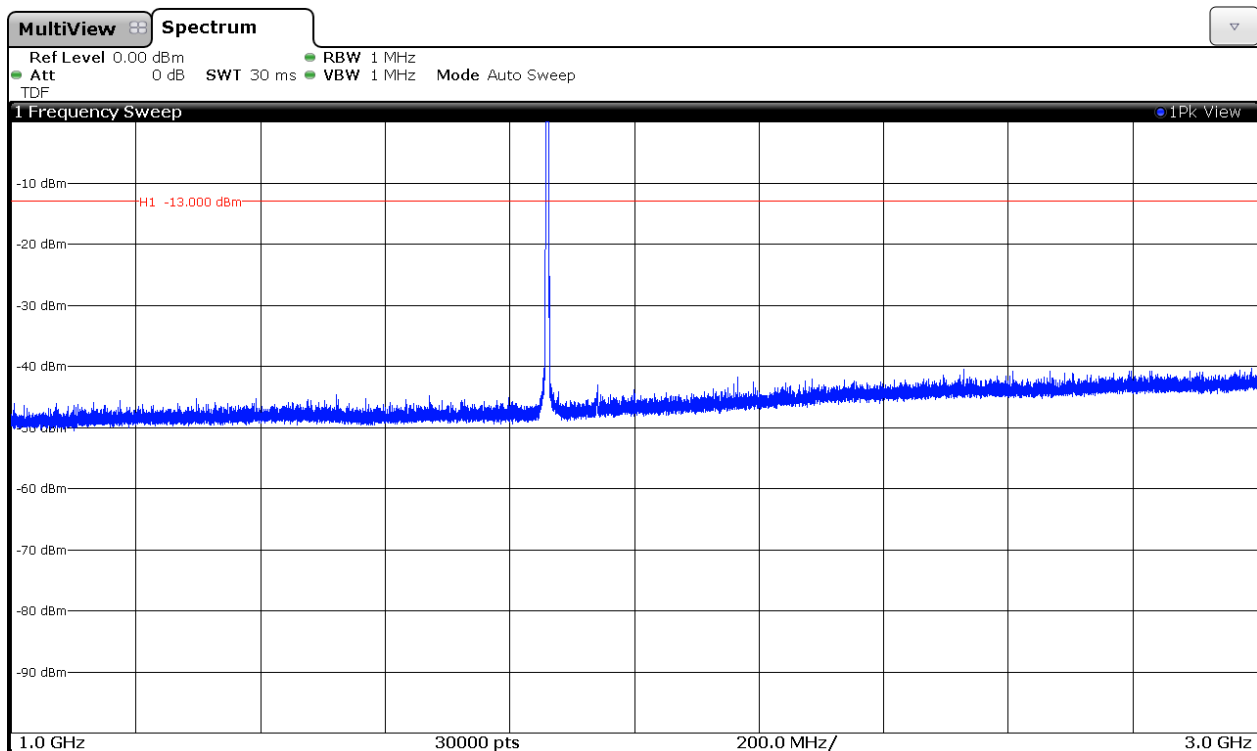
CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

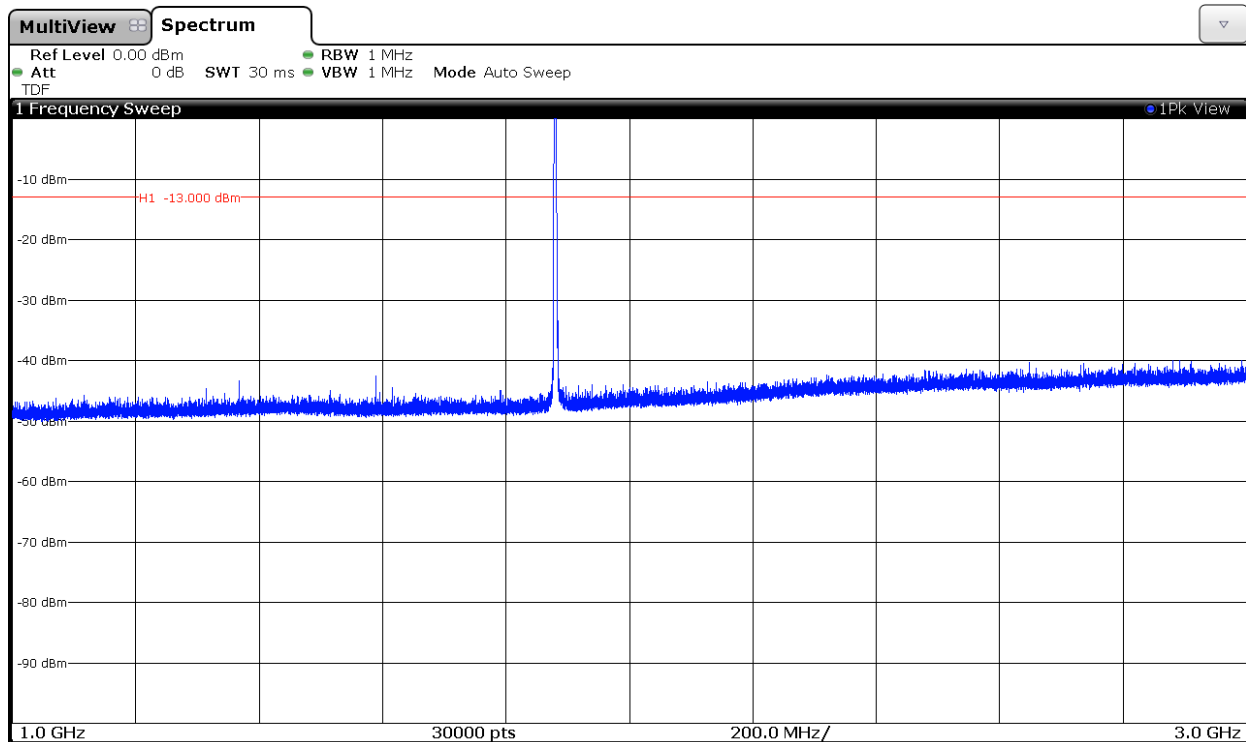
LTE QPSK MODULATION. BW=20 MHz. Band II

CHANNEL: LOWEST



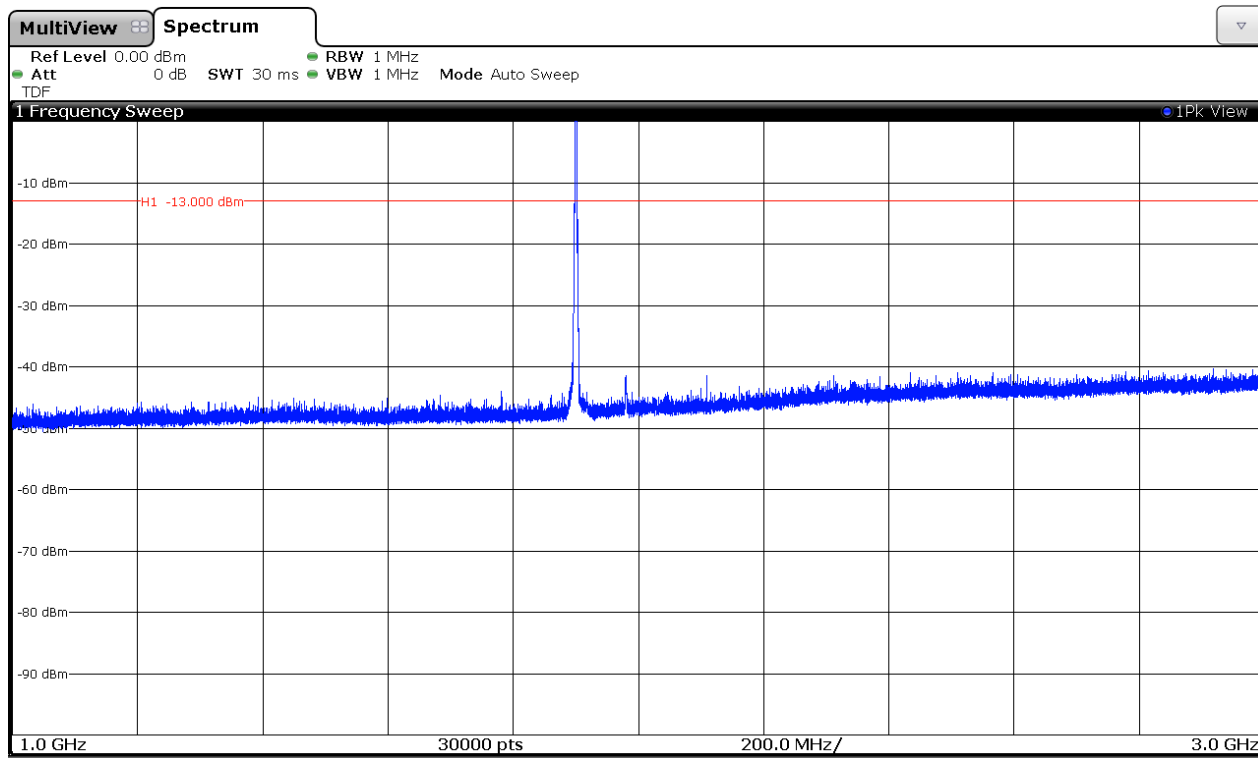
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

CHANNEL: HIGHEST

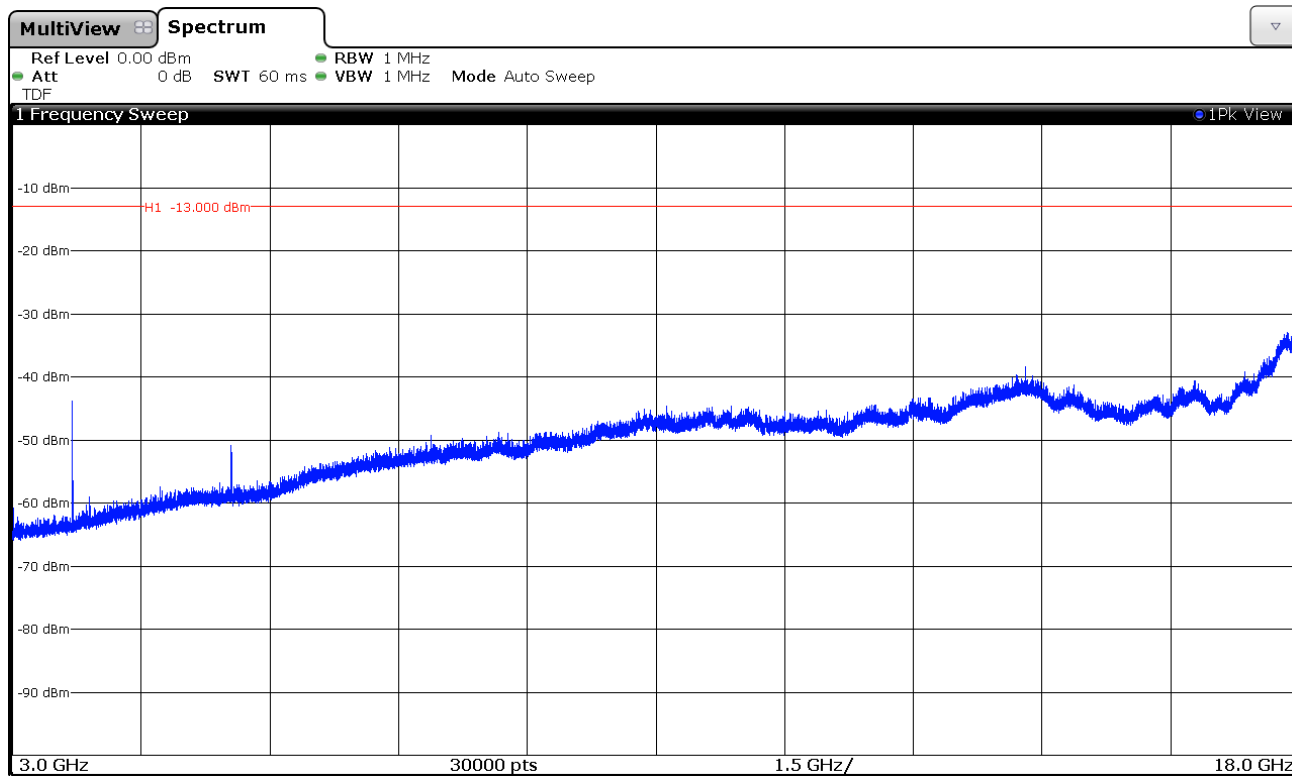


Note: The peak above the limit is the carrier frequency.

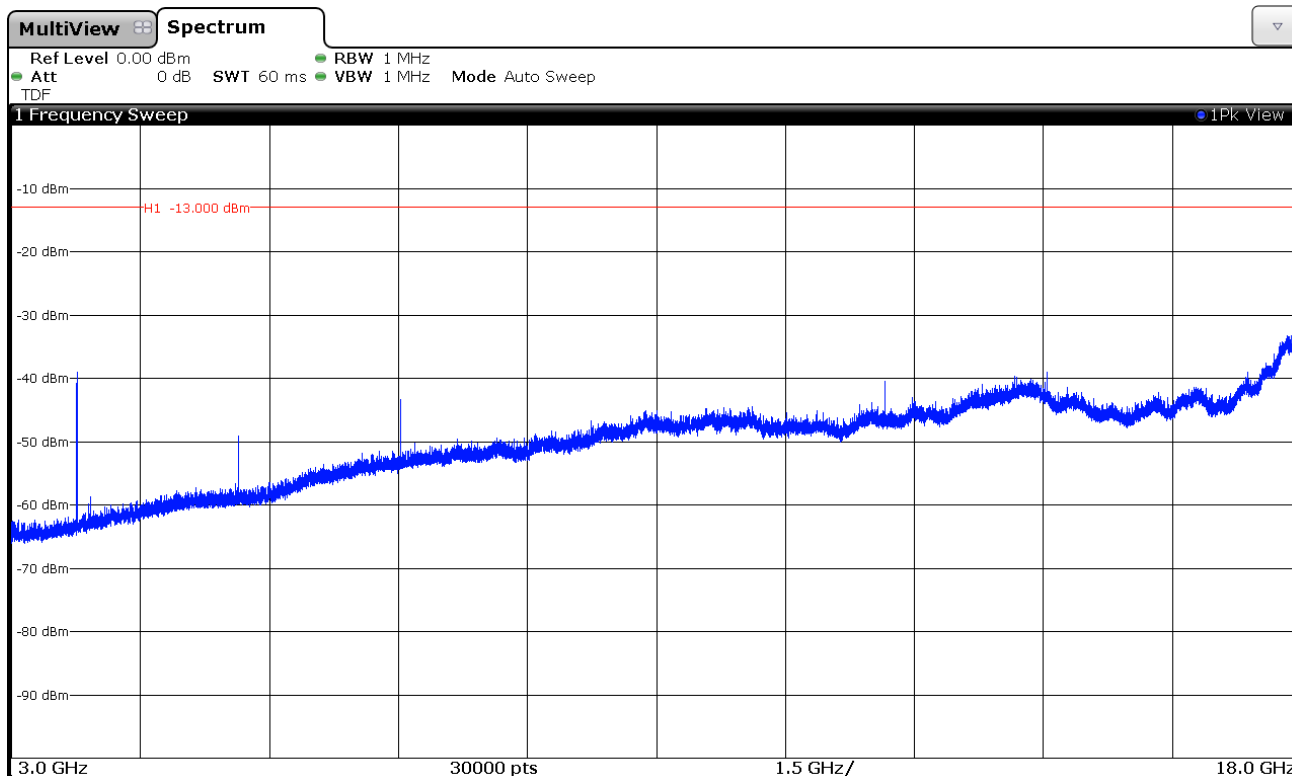
FREQUENCY RANGE 3 GHz to 18 GHz.

GPRS MODULATION

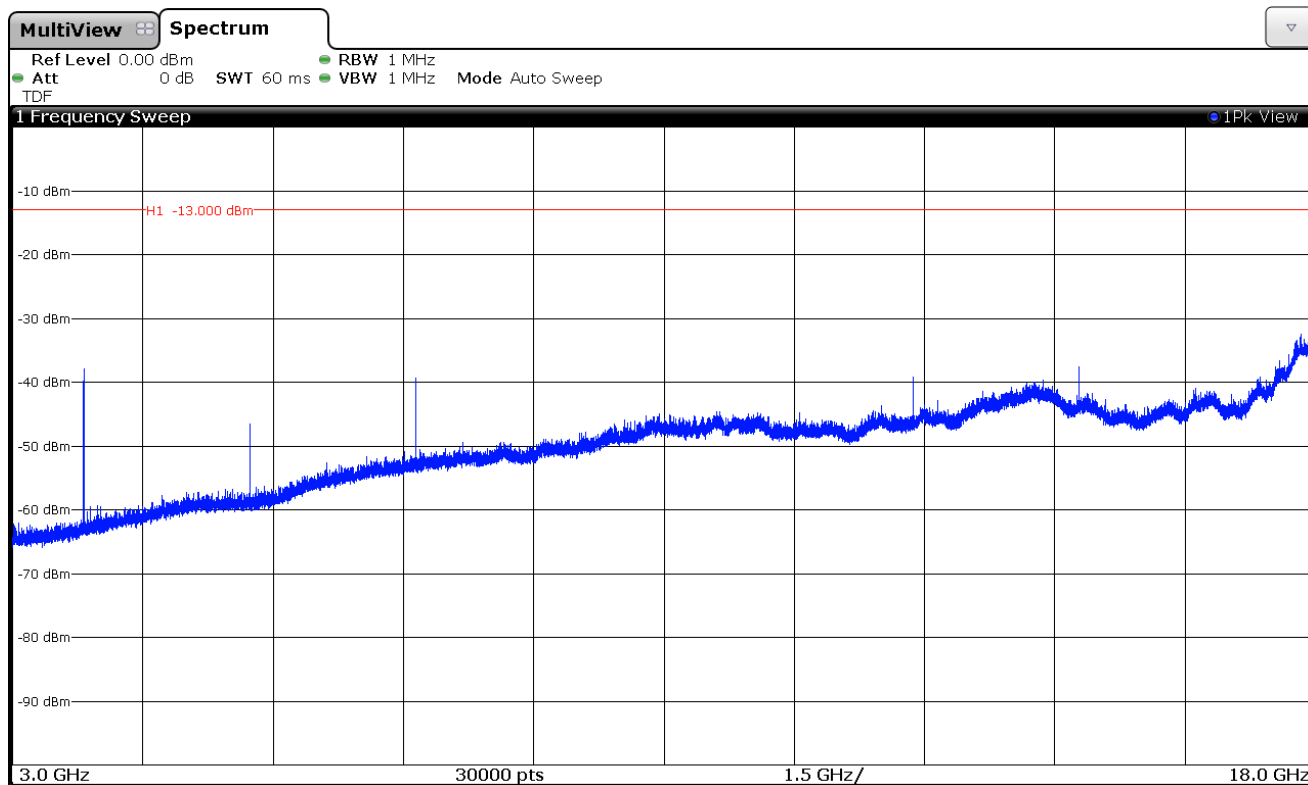
CHANNEL: LOWEST



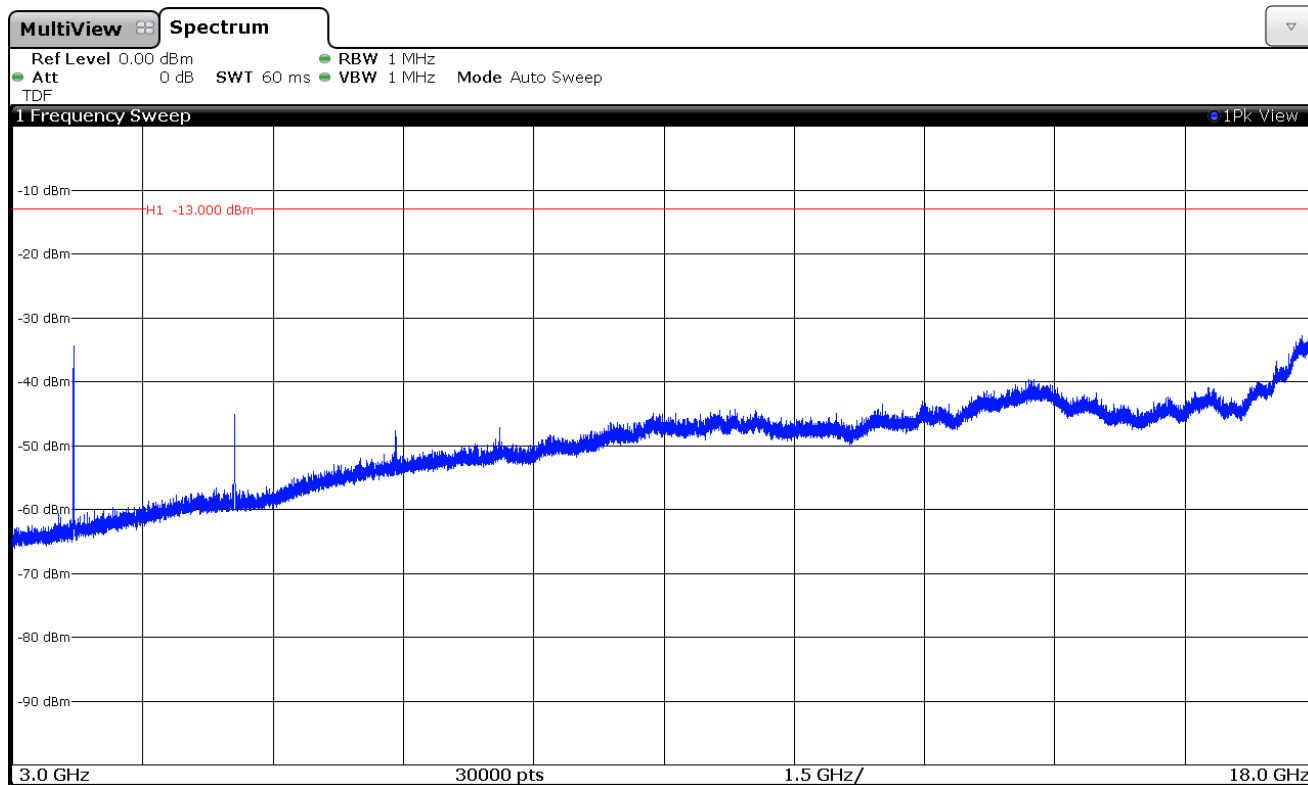
CHANNEL: MIDDLE



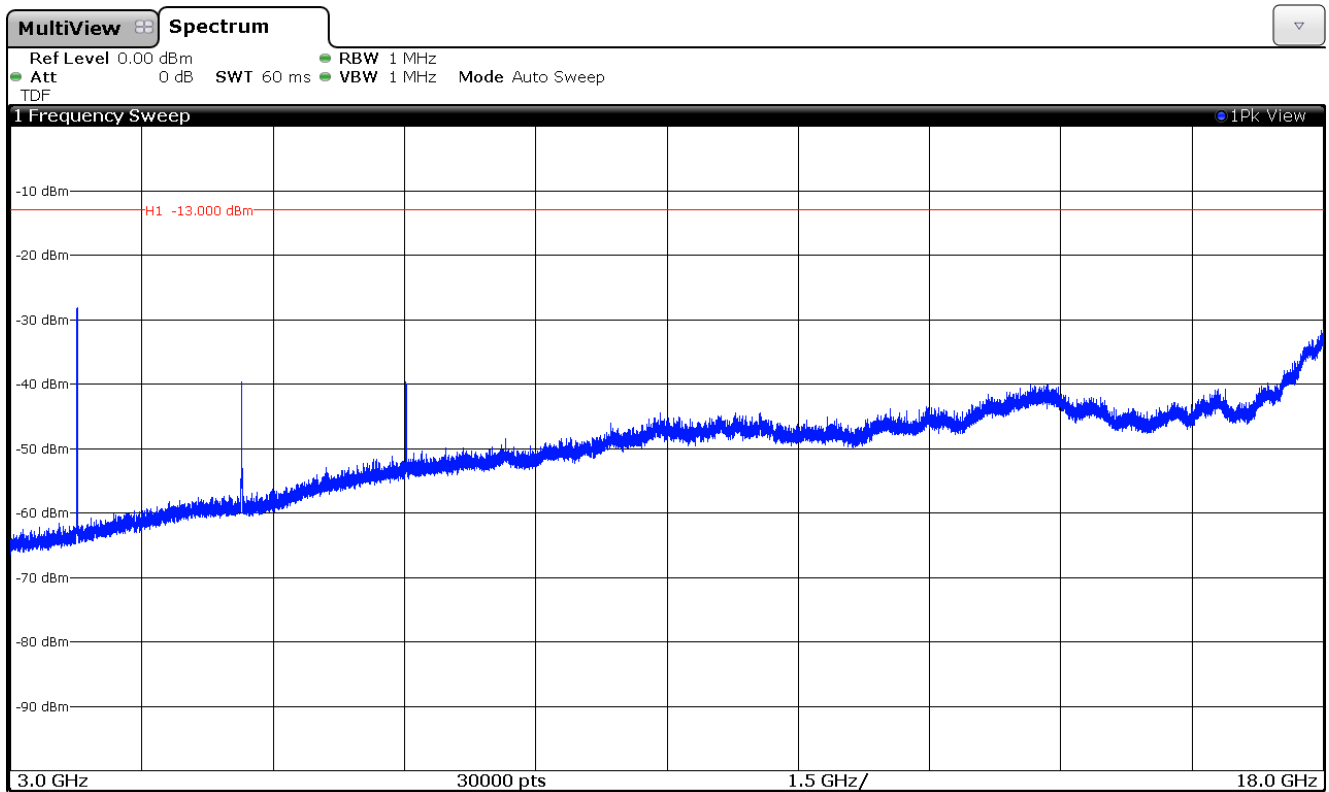
CHANNEL: HIGHEST



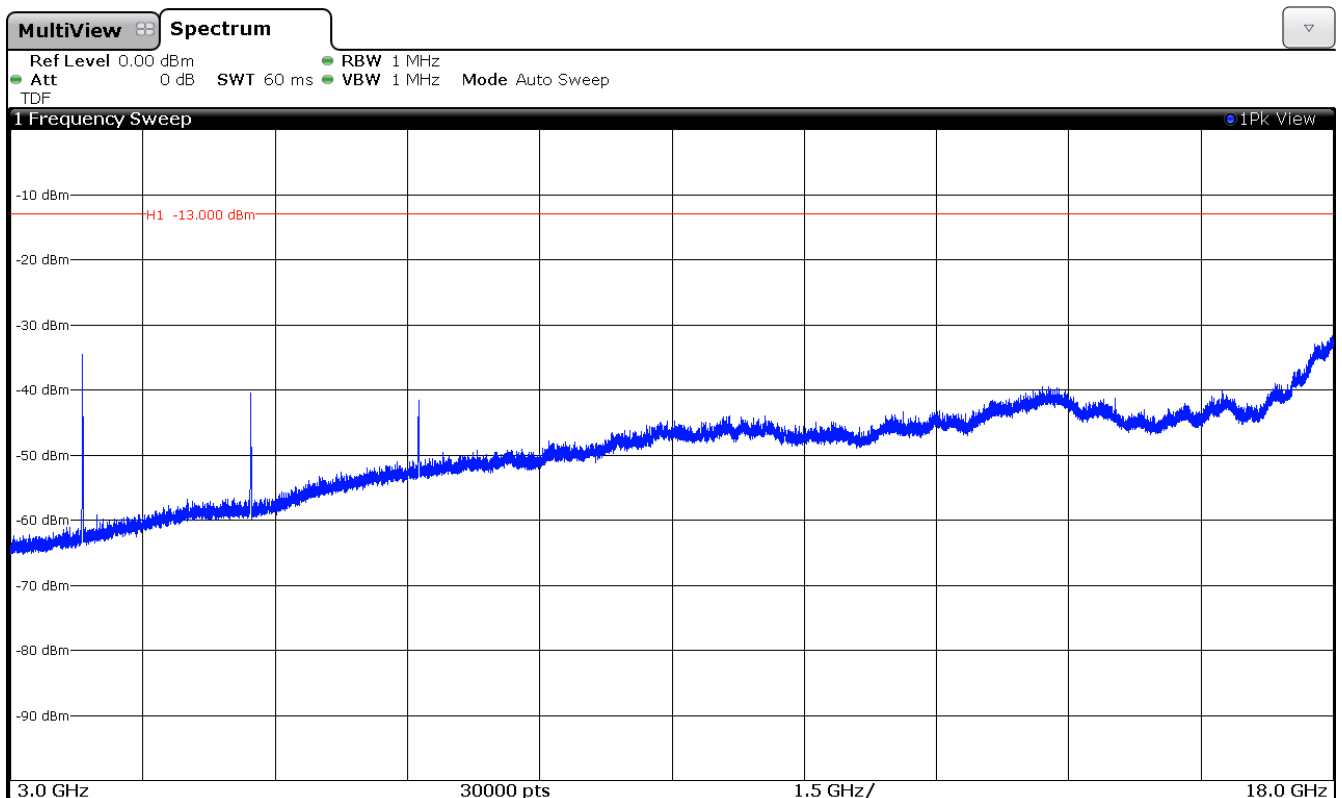
WCDMA MODULATION CHANNEL: LOWEST



CHANNEL: MIDDLE

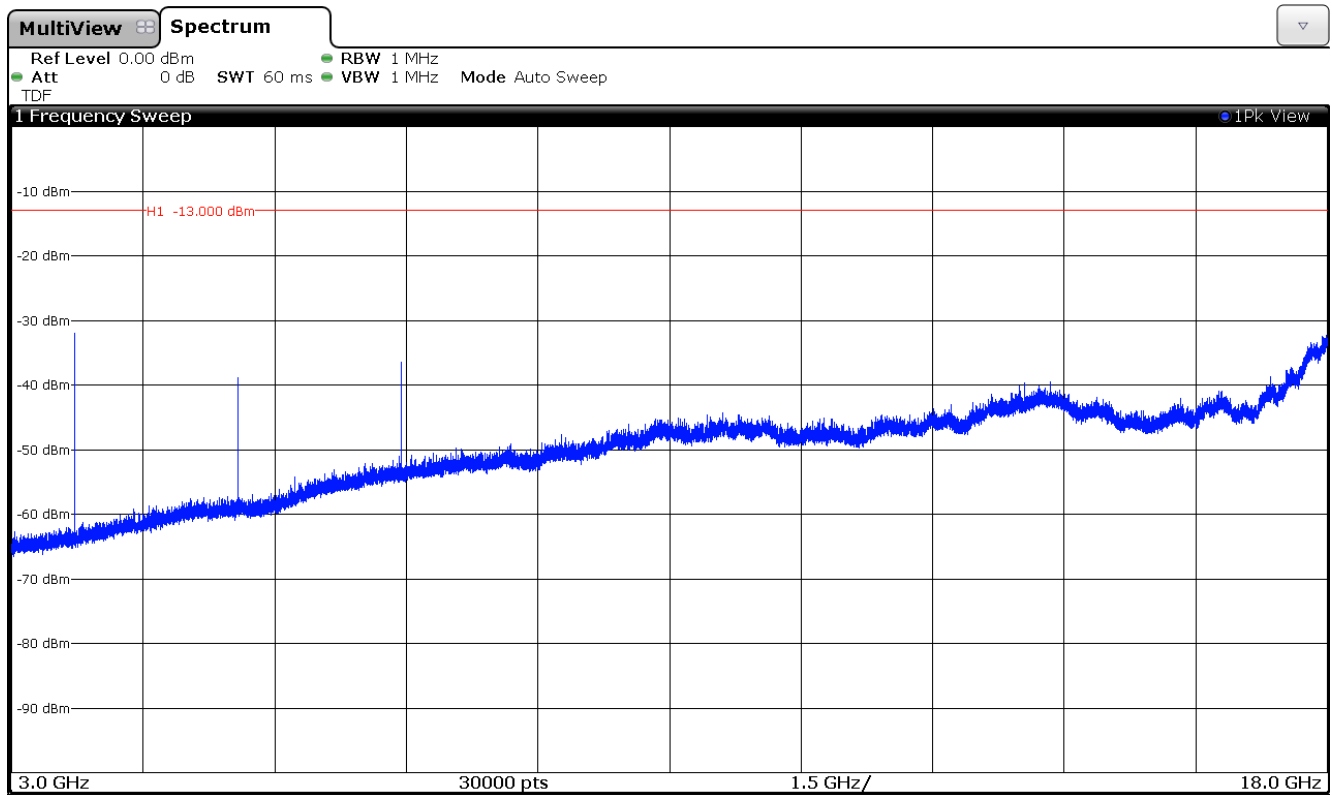


CHANNEL: HIGHEST

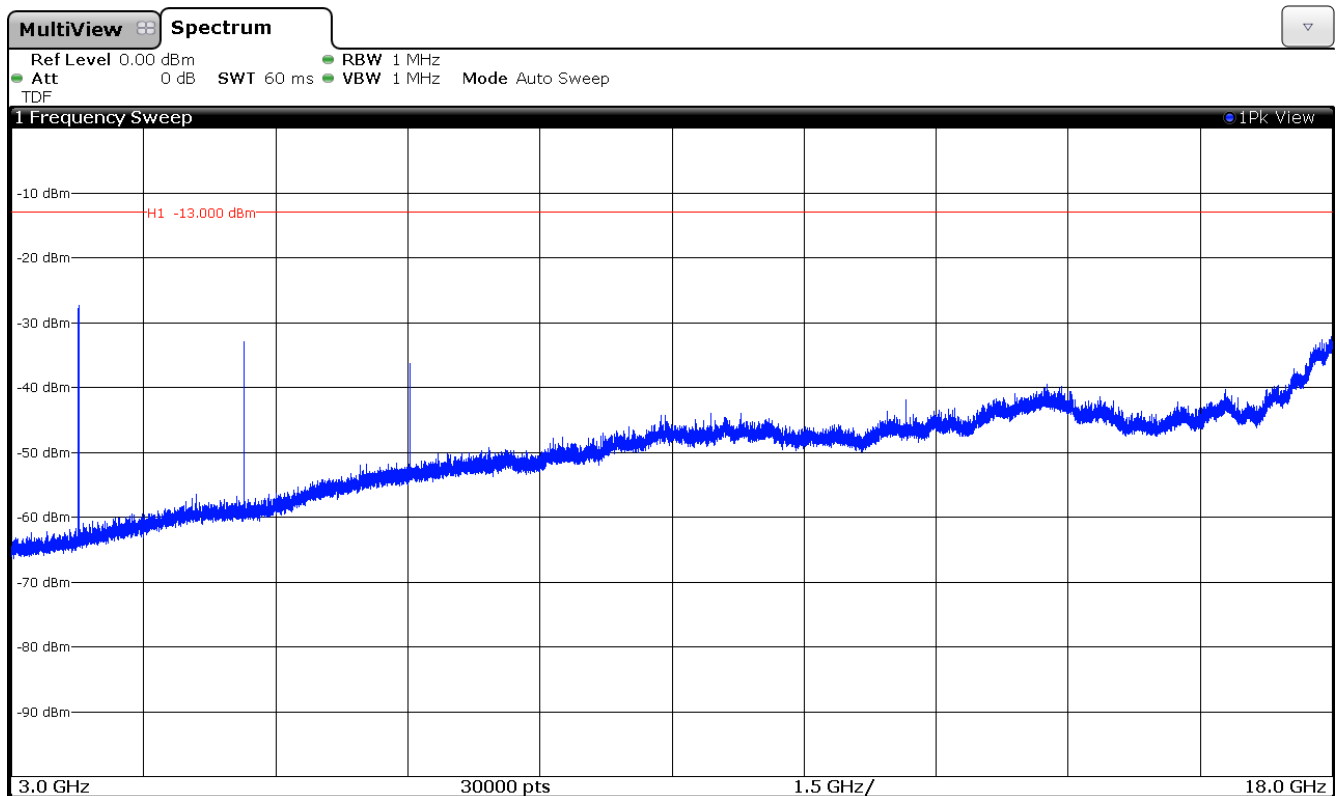


LTE QPSK MODULATION. BW=20 MHz. Band II

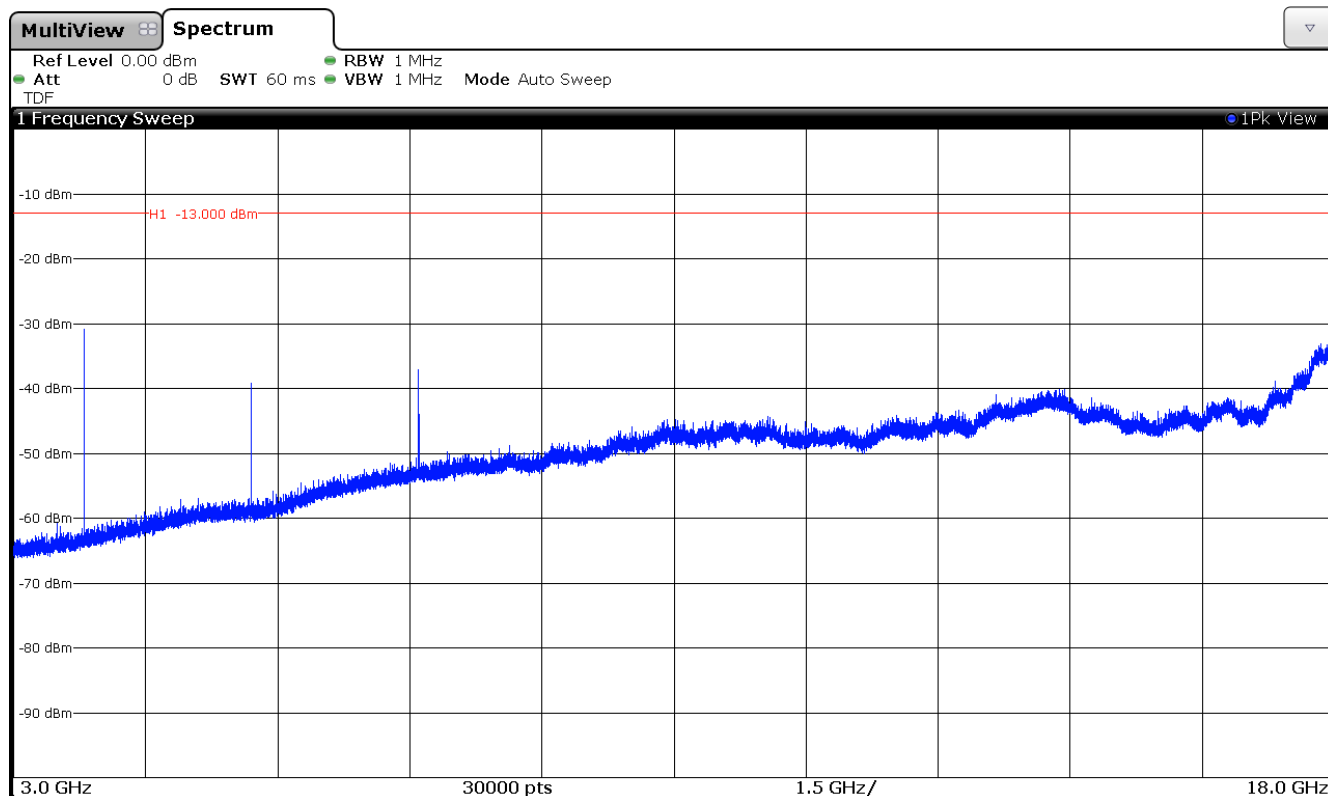
CHANNEL: LOWEST



CHANNEL: MIDDLE

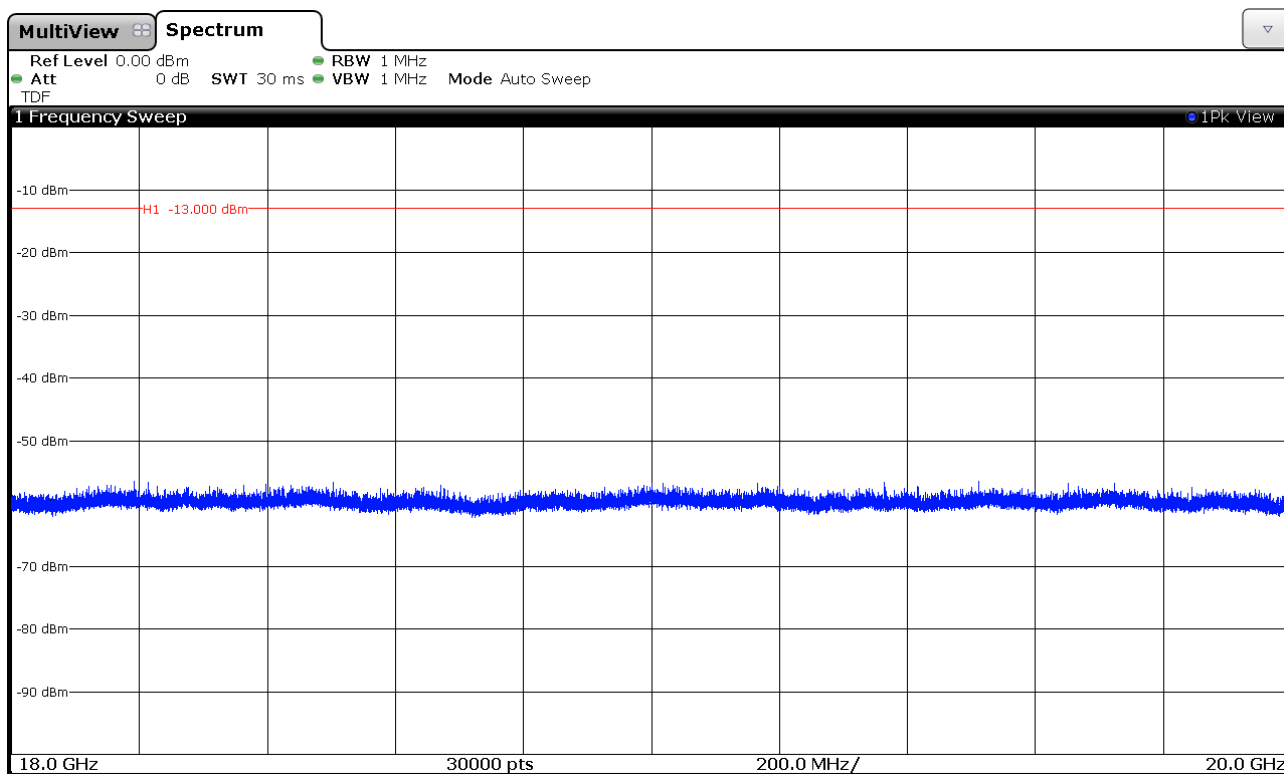


CHANNEL: HIGHEST



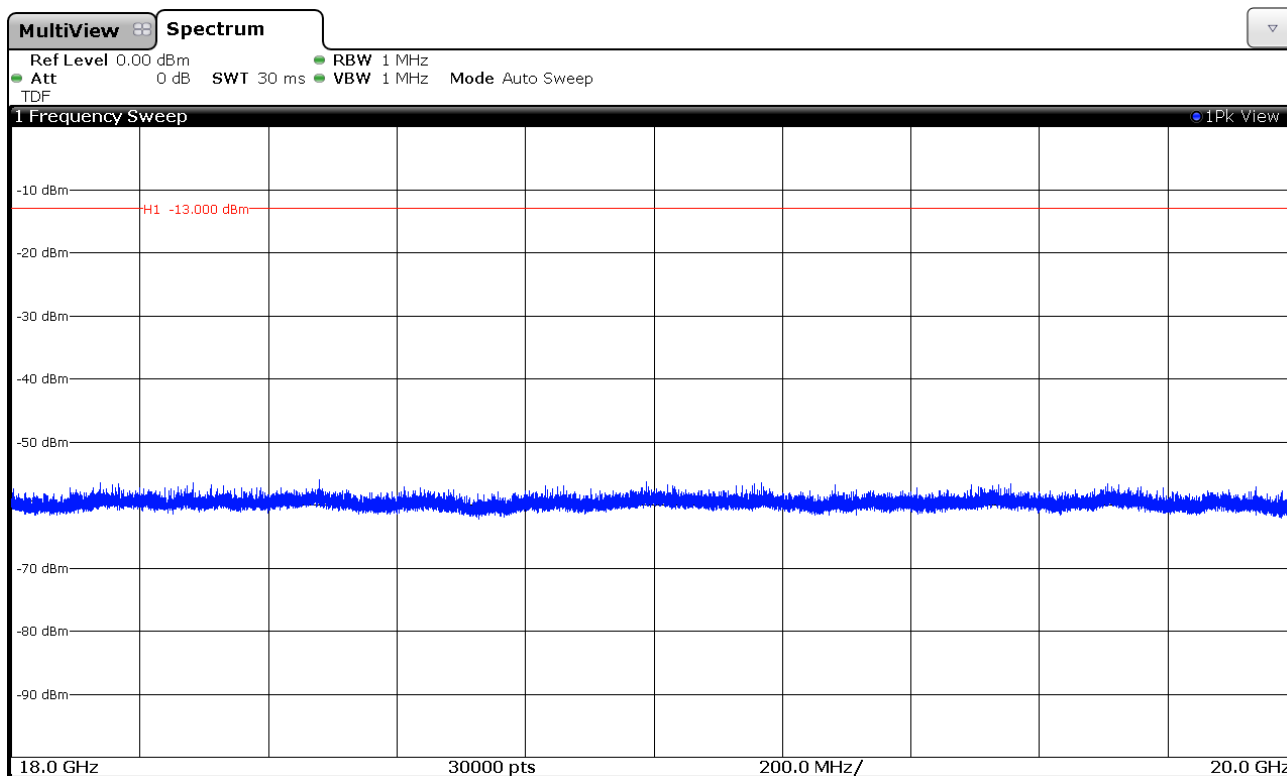
FREQUENCY RANGE 18 GHz TO 20 GHz.

GPRS MODULATION



(This plot is valid for all three channels)

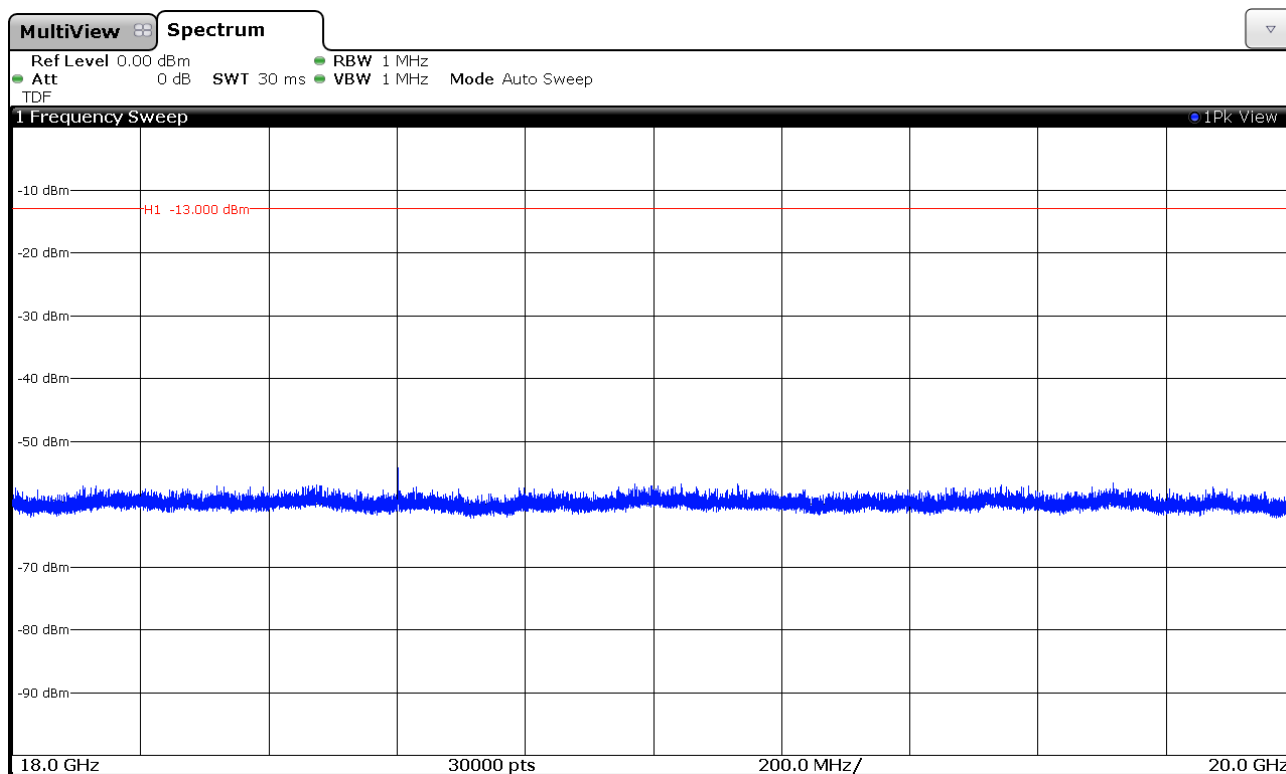
WCDMA MODULATION



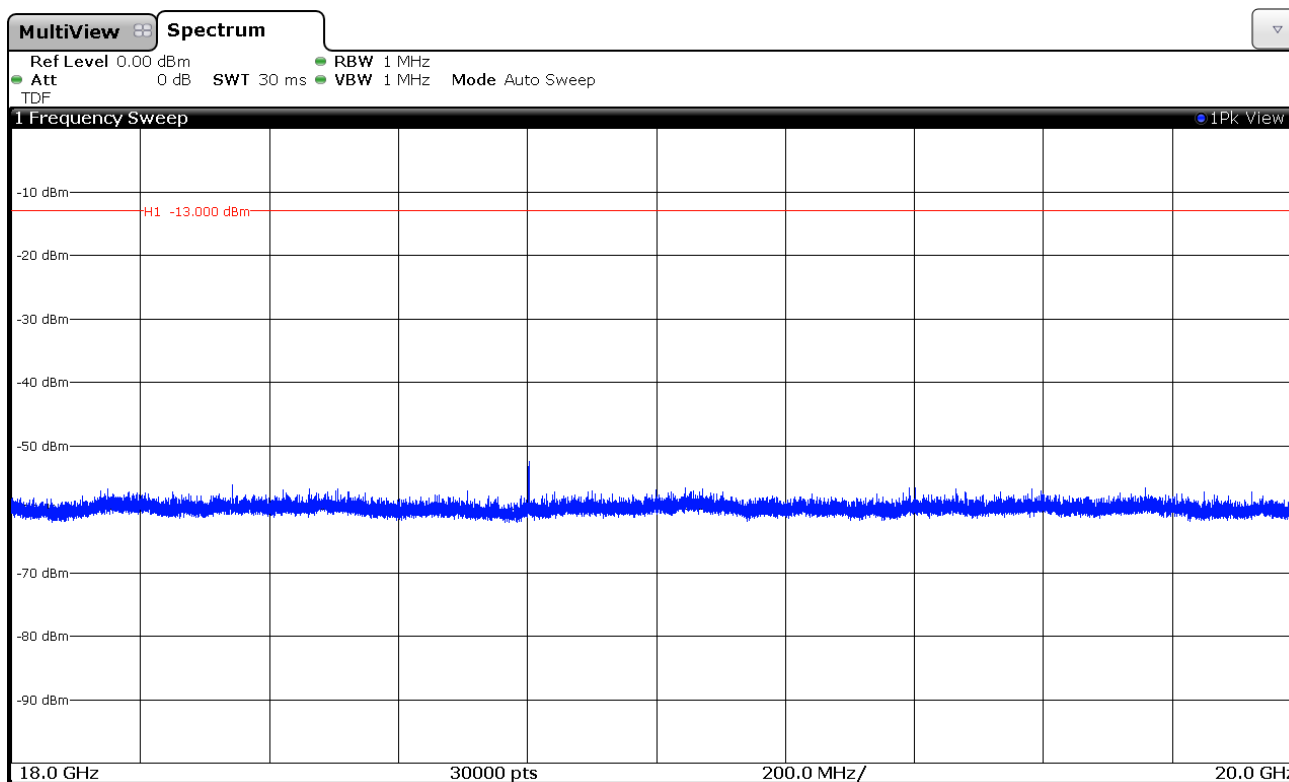
(This plot is valid for all three channels)

LTE QPSK MODULATION. BW=20 MHz. Band II

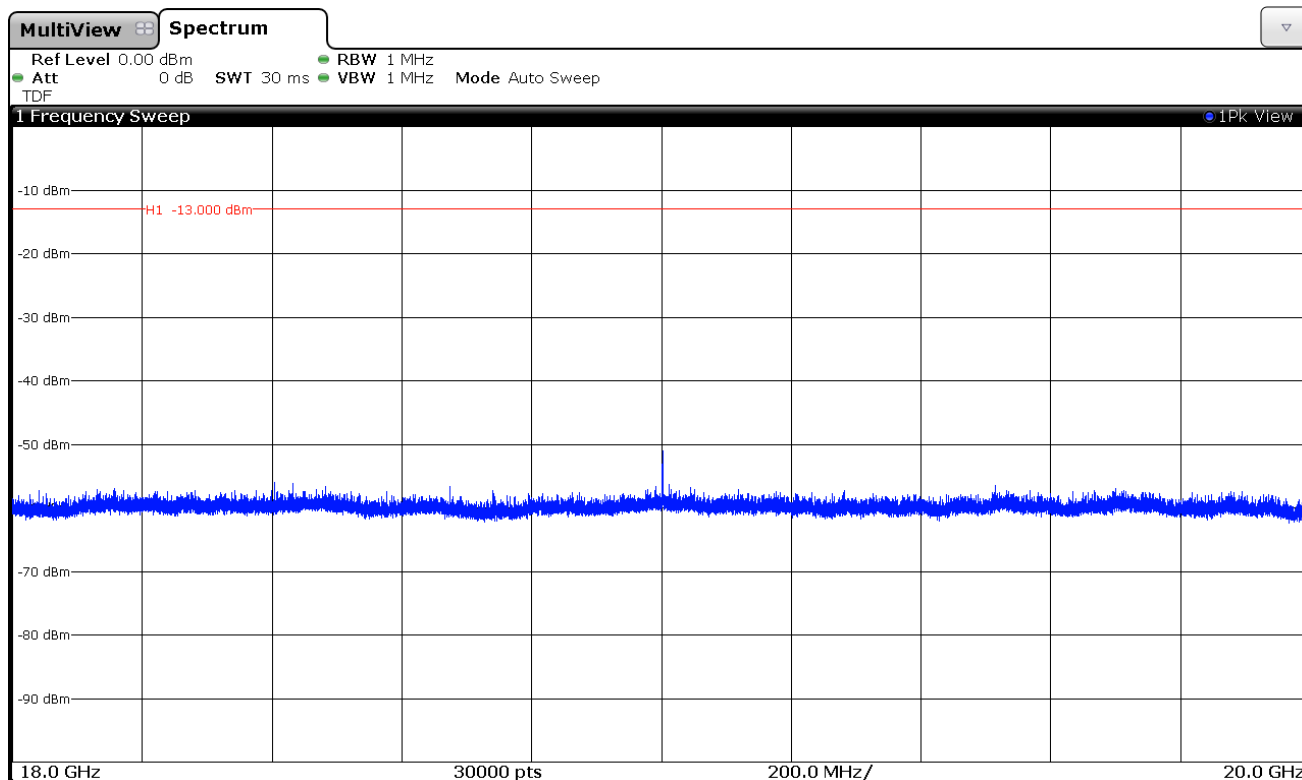
CHANNEL: LOWEST



CHANNEL: MIDDLE



CHANNEL: HIGHEST



Appendix C – Test result for FCC Part 27/IC RSS-139/IC RSS-130

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Radiated emissions56

TEST RESULTS FOR FCC PART 27 AND IC RSS-139/RSS-130

TEST CONDITIONS

Power supply (V):

$$V_{\text{nom}} = 3.6 \text{ Vdc}$$

$$V_{\text{max}} = \text{N/A}$$

$$V_{\text{min}} = \text{N/A}$$

The subscripts nom, min and max indicate voltage test conditions (nominal, minimum and maximum respectively, as declared by the applicant).

N/A: Not Applicable.

Type of power supply = DC voltage from rechargeable battery.

Type of antenna = External attachable antennae.

TEST FREQUENCIES:

LTE. QPSK AND 16QAM MODULATION (BAND IV)

	Channel (Frequency, MHz)					
	BW = 1.4 MHz	BW = 3 MHz	BW = 5 MHz	BW = 10 MHz	BW = 15 MHz	BW = 20 MHz
Lowest	19957 (1710.70)	19965 (1711.50)	19975 (1712.50)	20000 (1715.00)	20025 (1717.50)	20050 (1720.00)
Middle	20175 (1732.50)	20175 (1732.50)	20175 (1732.50)	20175 (1732.50)	20175 (1732.50)	20175 (1732.50)
Highest	20350 (1754.30)	20385 (1753.50)	20375 (1752.50)	20350 (1750.00)	20325 (1747.50)	20300 (1745.00)

LTE. QPSK AND 16QAM MODULATION (BAND XVII)

	Channel (Frequency, MHz)	
	BW = 5 MHz	BW = 10 MHz
Lowest	23755 (706.50)	23780 (709.00)
Middle	23790 (710.00)	23790 (710.00)
Highest	23825 (713.50)	23800 (711.00)

Radiated emissions

SPECIFICATION

FCC §2.1051 and §27.53(g) (h). RSS-139 Clause 6.6. RSS-130 Clause 4.6.

According to specification, the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. P in watts.

METHOD

The measurement was performed with the EUT inside an anechoic chamber. The spectrum was scanned from 30 MHz to at least the 10th harmonic of the highest frequency generated within the equipment.

The EUT was placed on a 1.5 meter high non-conductive stand at a 3 meter distance from the measuring antenna for measurements below 1 GHz and at 1 m distance for measurements above 1 GHz.

Detected emissions were maximized at each frequency by rotating the EUT and adjusting the measuring antenna height and polarization. The maximum meter reading was recorded. The radiated emissions were measured with peak detector and 1 MHz bandwidth.

Each detected emission at less than 20 dB below the limit is substituted by the Substitution method, in accordance with the ANSI/TIA/EIA-603-D.

Measurement Limit:

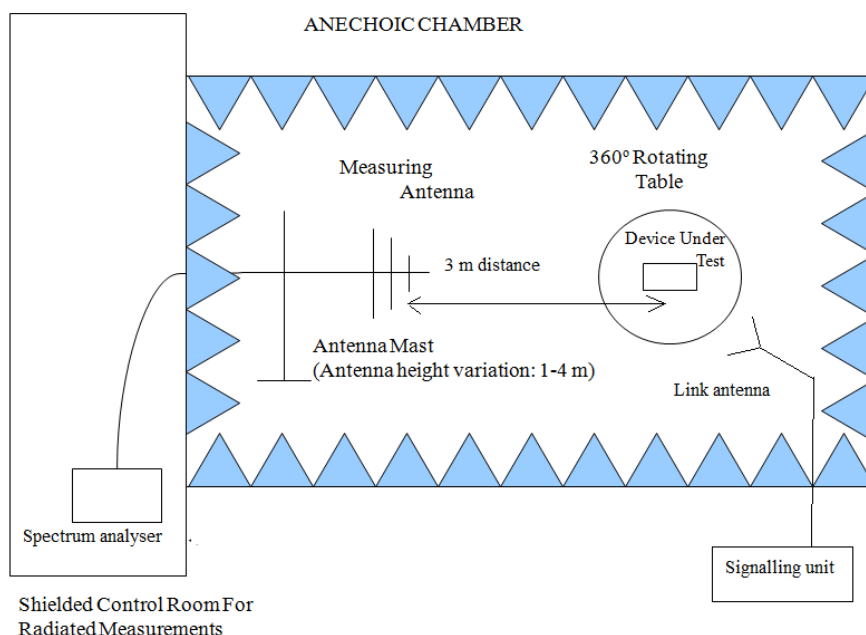
According to specification, the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. P in watts.

At P_o transmitting power, the specified minimum attenuation becomes $43 + 10 \log (P_o)$ and the level in dBm relative P_o becomes:

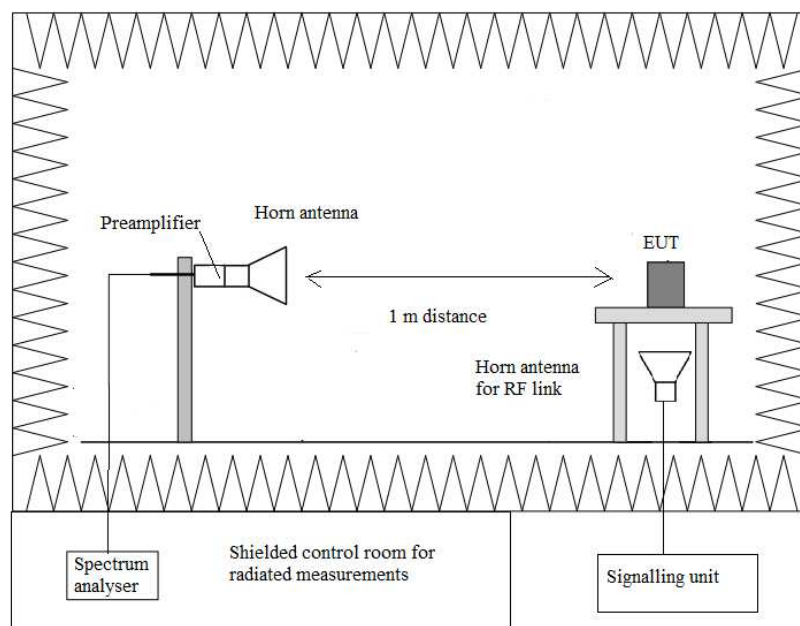
$$P_o \text{ (dBm)} - [43 + 10 \log (P_o \text{ in mwatts}) - 30] = -13 \text{ dBm}$$

TEST SETUP

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



RESULTS

LTE QPSK AND 16QAM MODULATION. Band IV. BW = 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz and 20 MHz.

A preliminary scan determined the QPSK 1.4 MHz bandwidth as the worst case. The configuration of Resource Blocks which is the worst case for conducted power was used.

The following tables and plots show the results for this configuration.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-18 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain G_i (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
6842.75	-43.72	Vertical	-37.72	1.87	10.15	-31.37

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-18 GHz.

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain G_i (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
6930.25	-43.66	Vertical	-37.01	1.88	9.95	-30.96

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-18 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

LTE QPSK AND 16QAM MODULATION. Band XVII. BW = 5 MHz, 10 MHz, 15 MHz and 20 MHz.

A preliminary scan determined the QPSK 5 MHz bandwidth as the worst case. The configuration of Resource Blocks which is the worst case for conducted power was used.

The following tables and plots show the results for this configuration.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain G_i (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
1413.36	-19.33	Vertical	-30.29	1.50	7.63	-24.16

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain G_i (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
1420.50	-20.82	Vertical	-31.80	1.50	7.67	-25.63

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

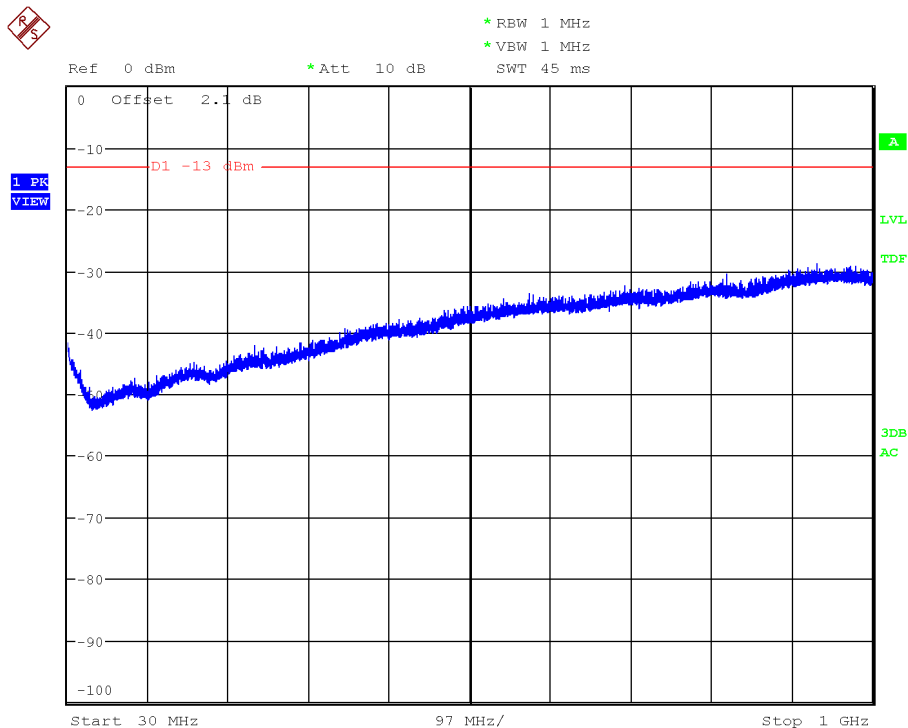
No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

FREQUENCY RANGE 30 MHz-1000 MHz.

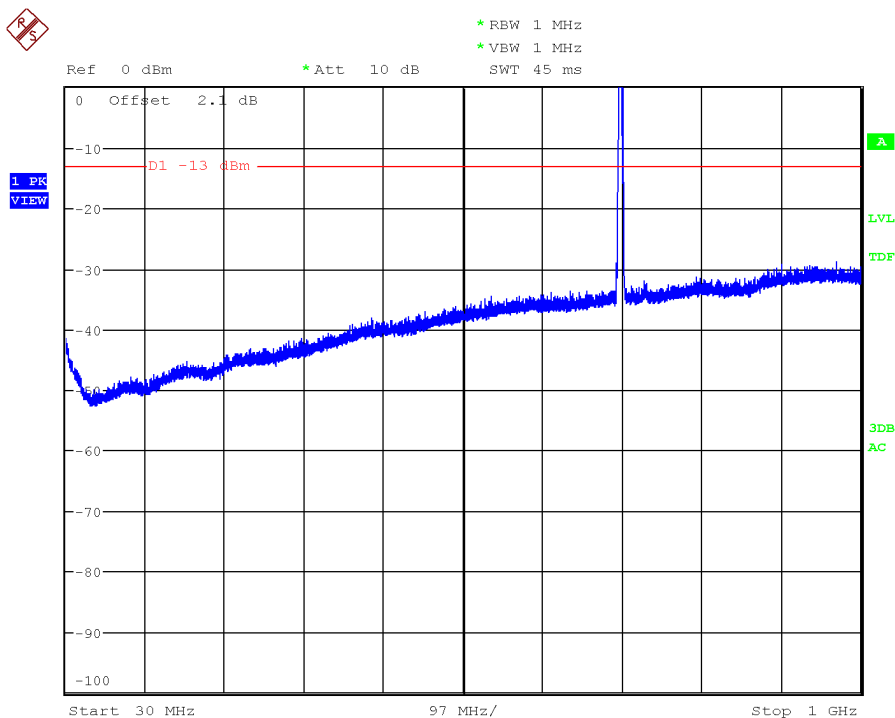
LTE QPSK MODULATION. BW=1.4 MHz. Band IV



(This plot is valid for all three channels)

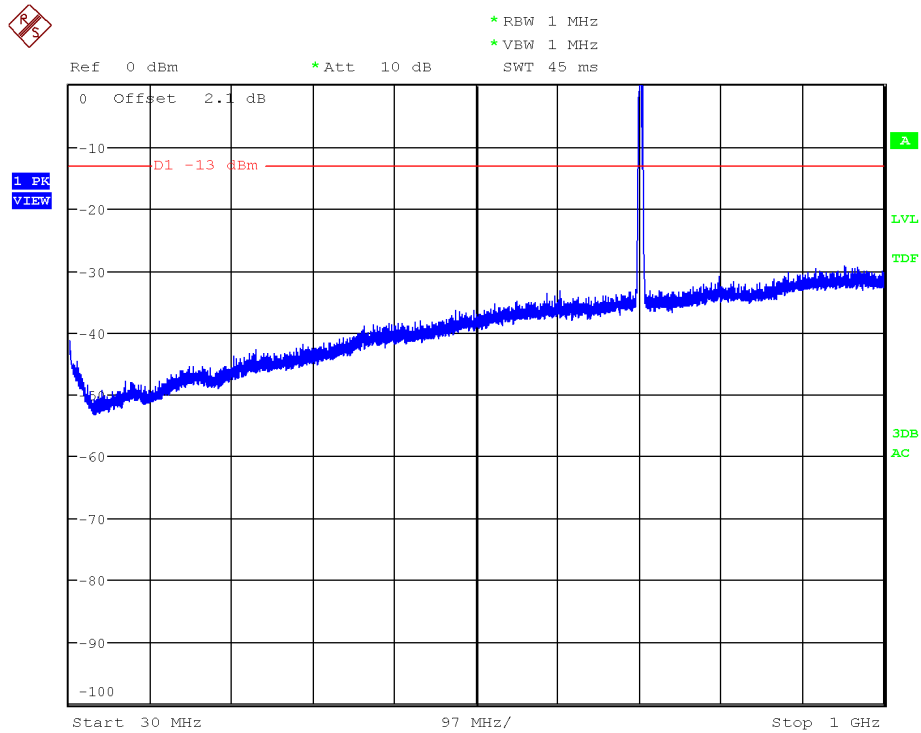
LTE QPSK MODULATION. BW=5 MHz. Band XVII

CHANNEL: LOWEST



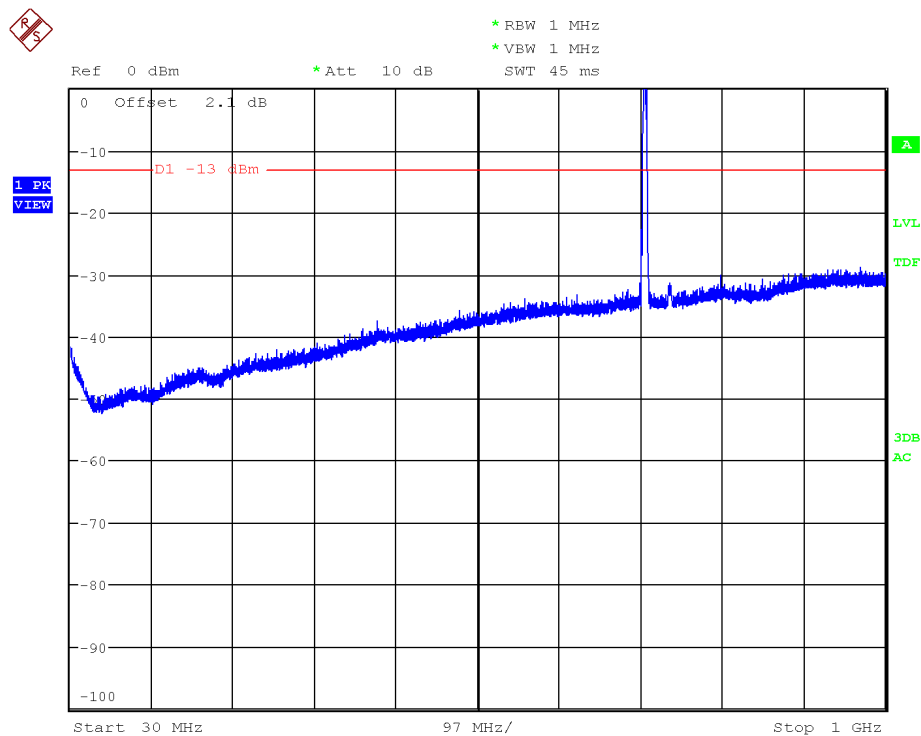
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

CHANNEL: HIGHEST

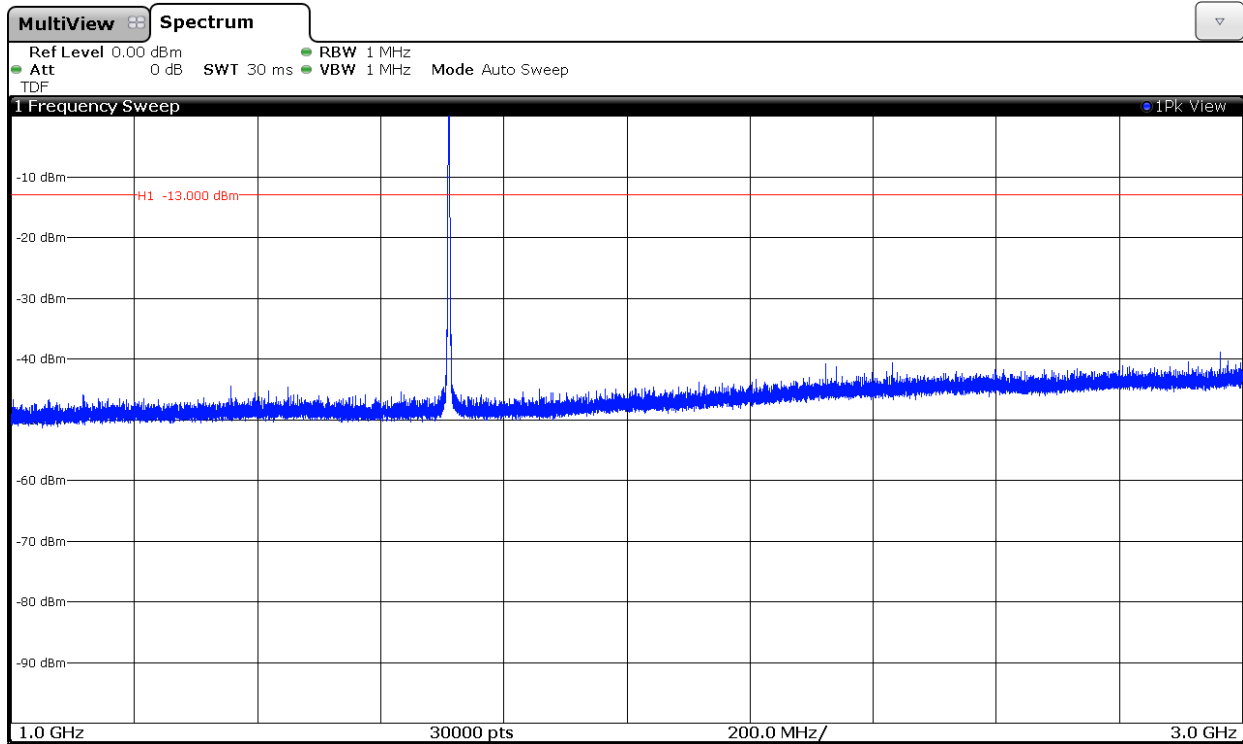


Note: The peak above the limit is the carrier frequency.

FREQUENCY RANGE 1 GHz to 3 GHz.

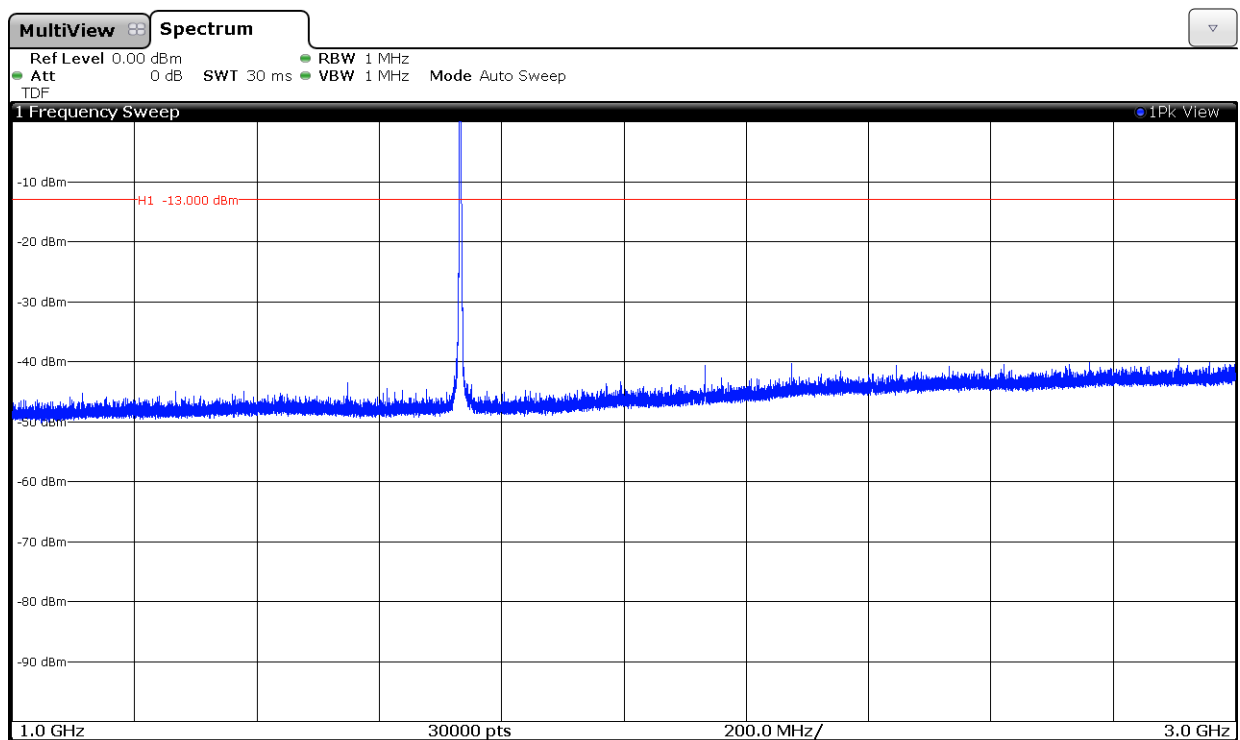
LTE QPSK MODULATION. BW=1.4 MHz. Band IV

CHANNEL: LOWEST



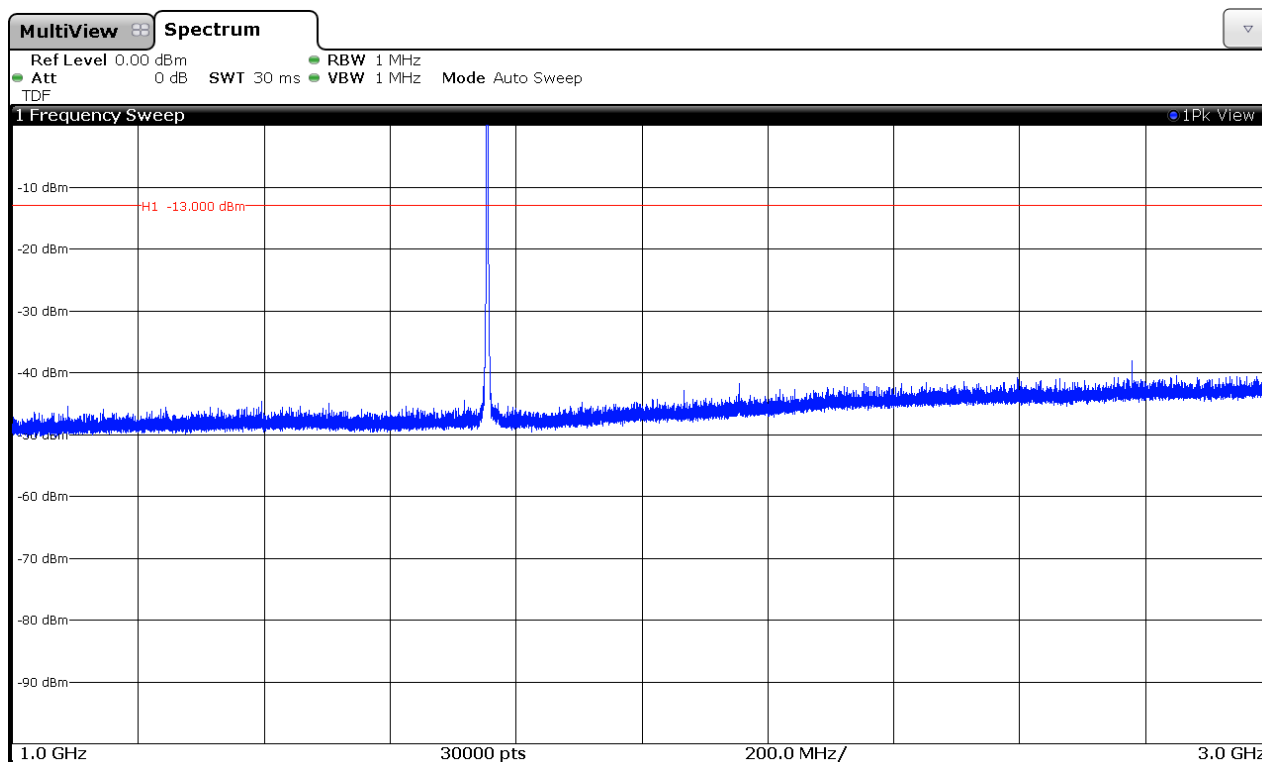
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

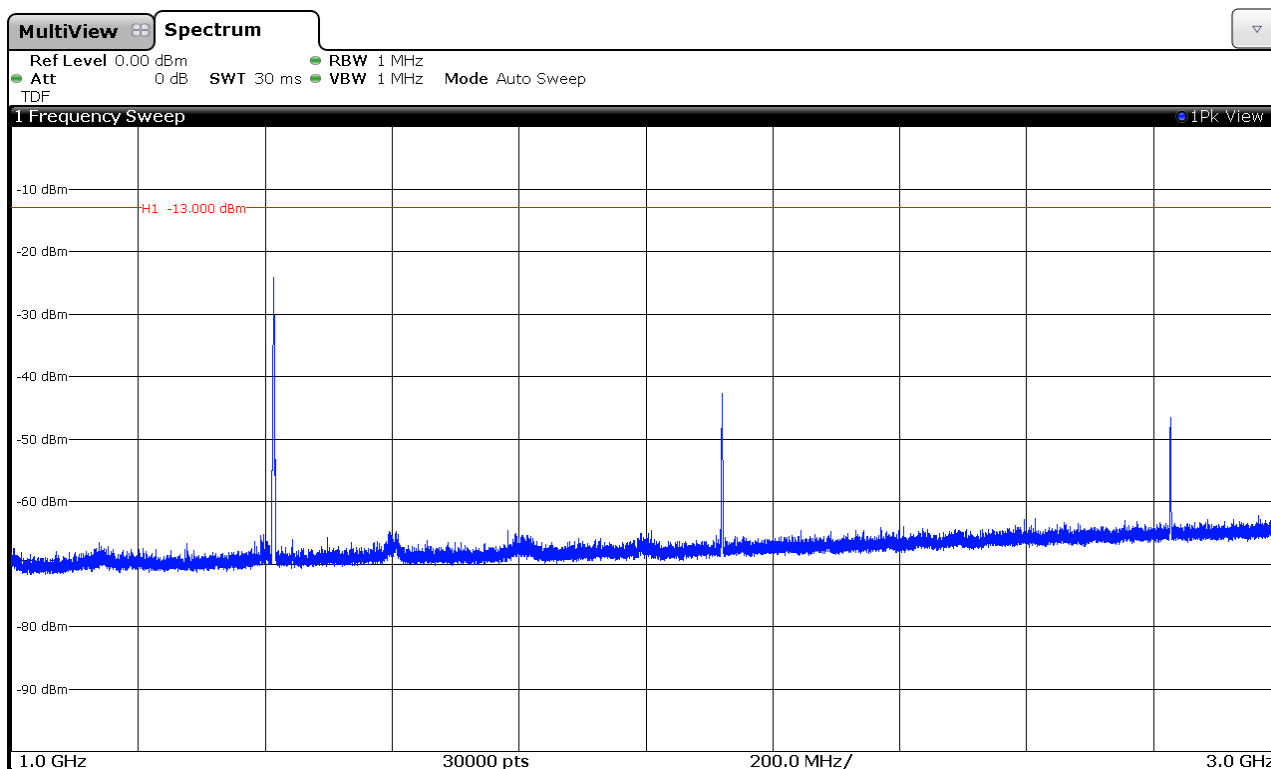
CHANNEL: HIGHEST



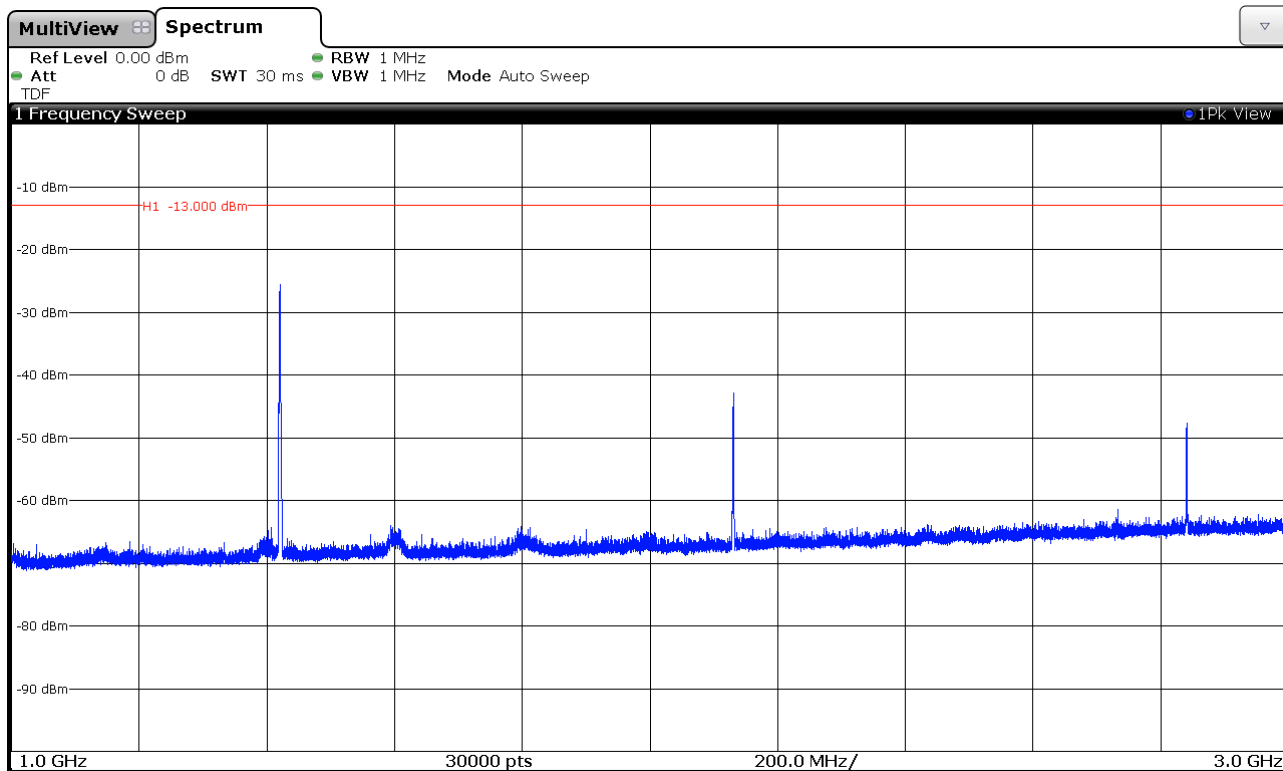
Note: The peak above the limit is the carrier frequency.

LTE QPSK MODULATION. BW=5 MHz. Band XVII

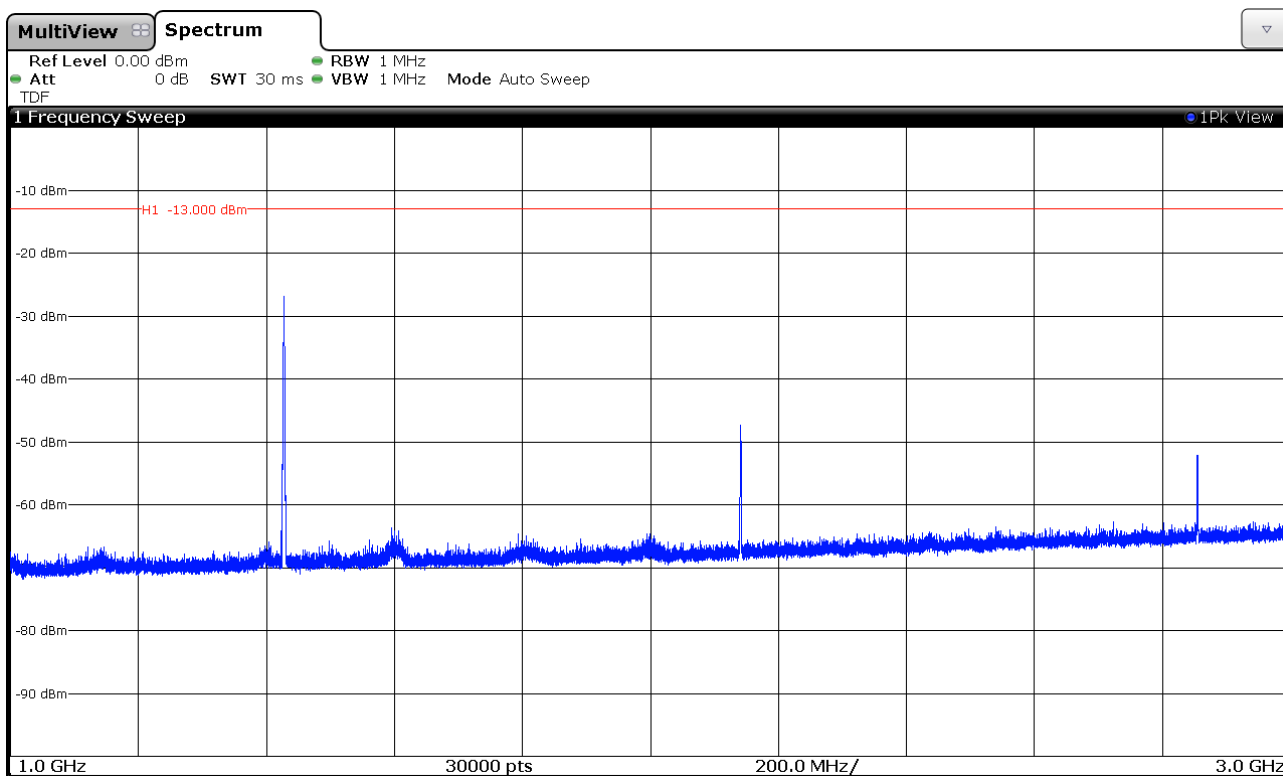
CHANNEL: LOWEST



CHANNEL: MIDDLE



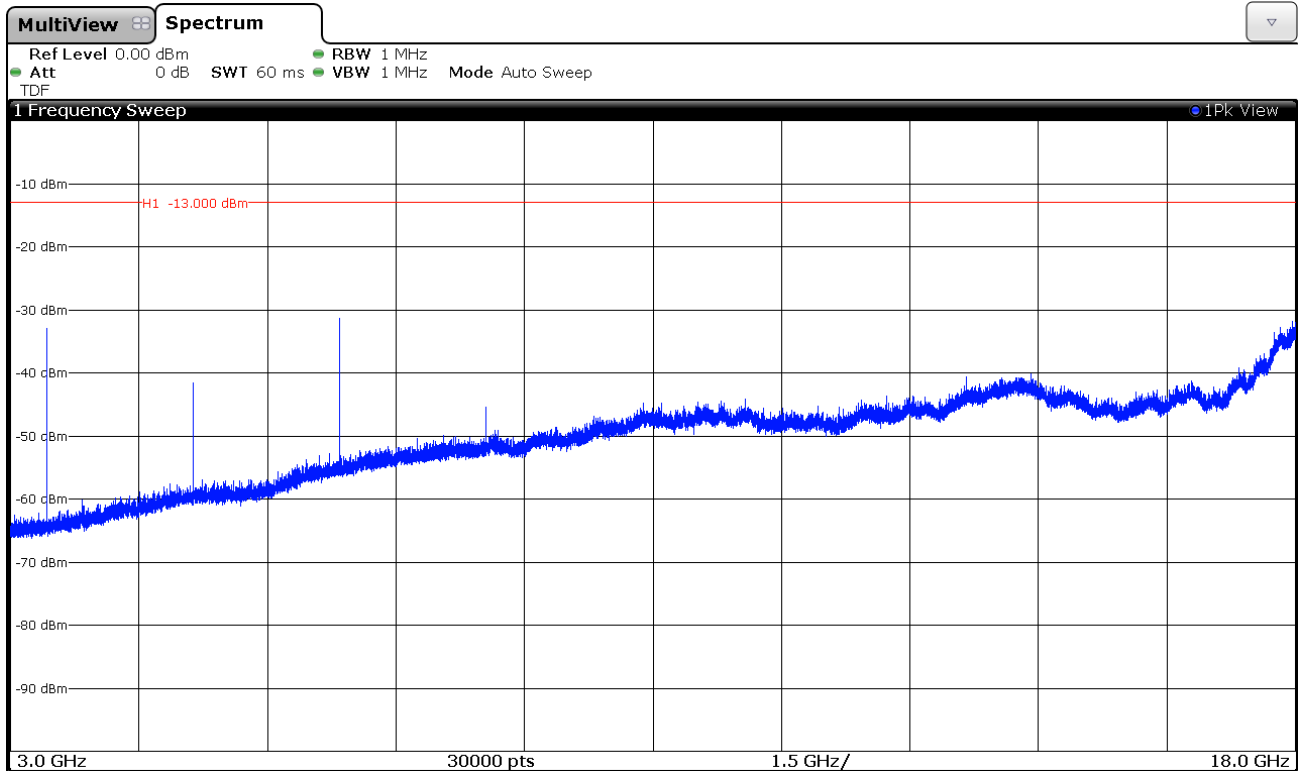
CHANNEL: HIGHEST



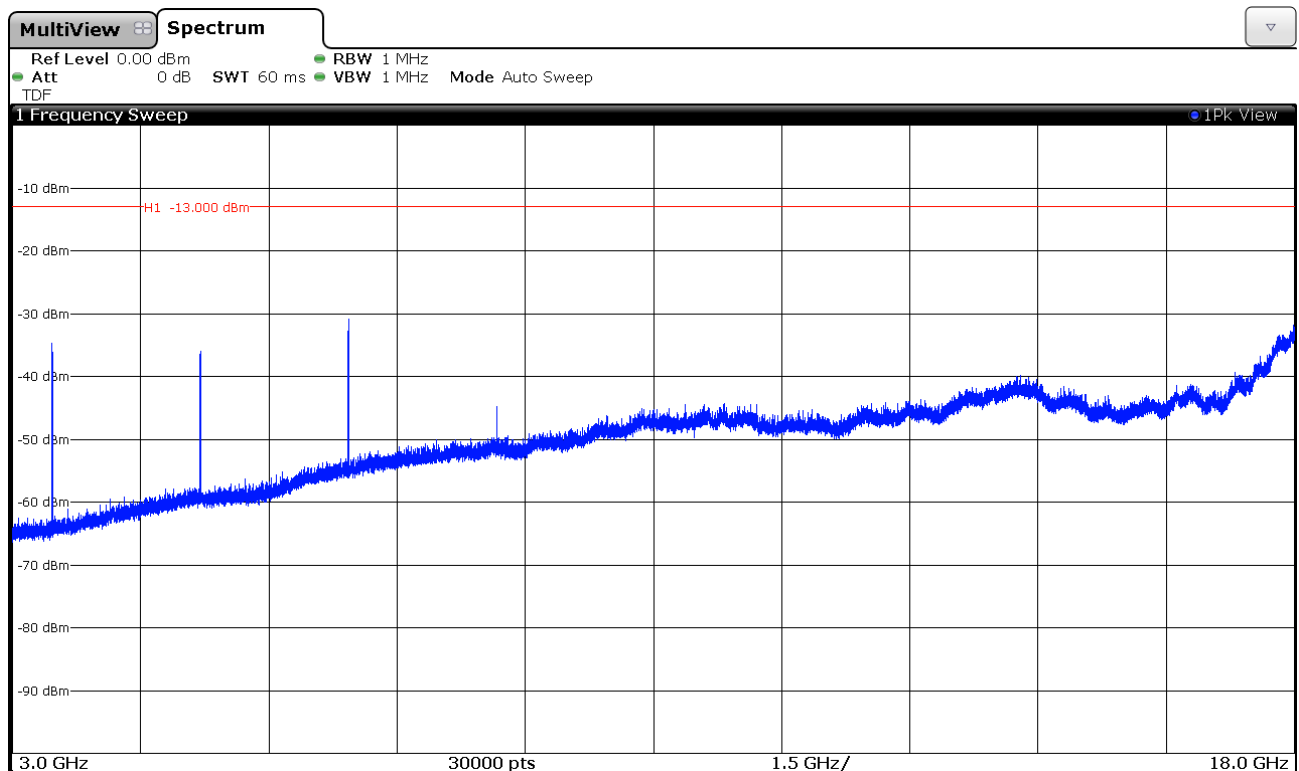
FREQUENCY RANGE 3 GHz to 18 GHz.

LTE QPSK MODULATION. BW=1.4 MHz. Band IV

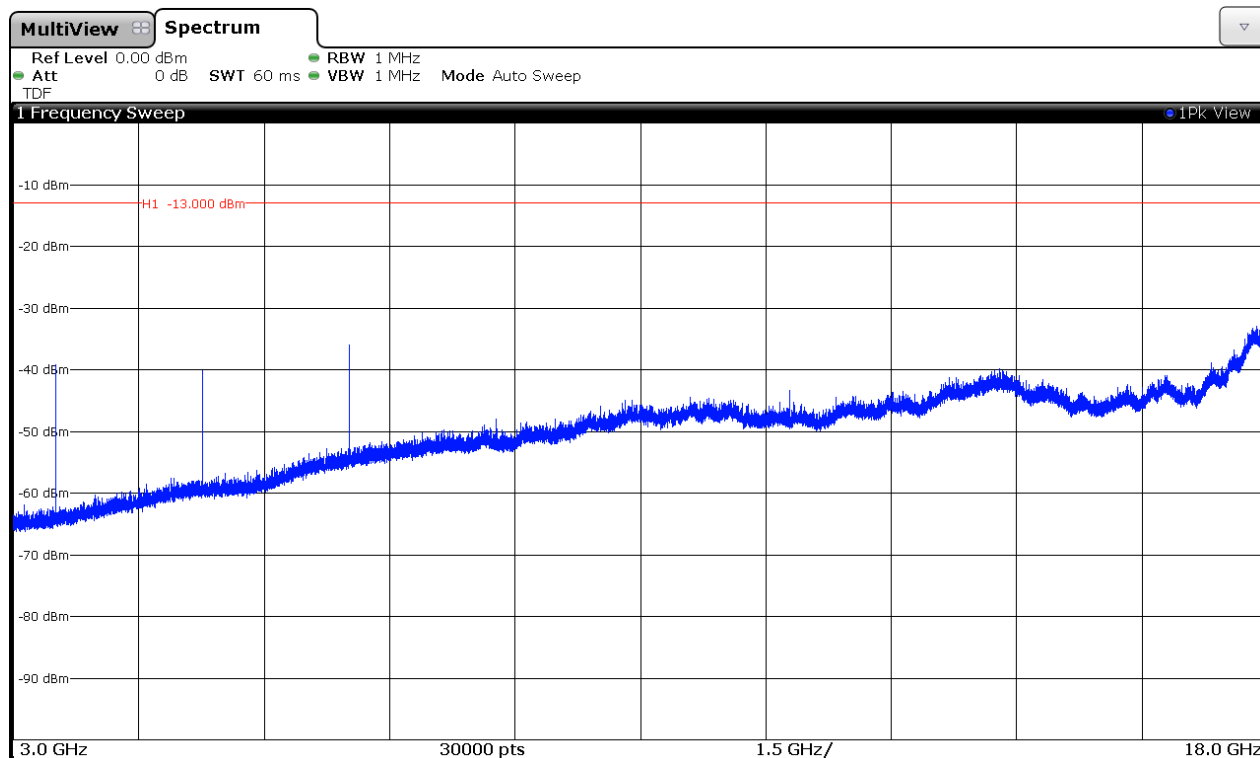
CHANNEL: LOWEST



CHANNEL: MIDDLE



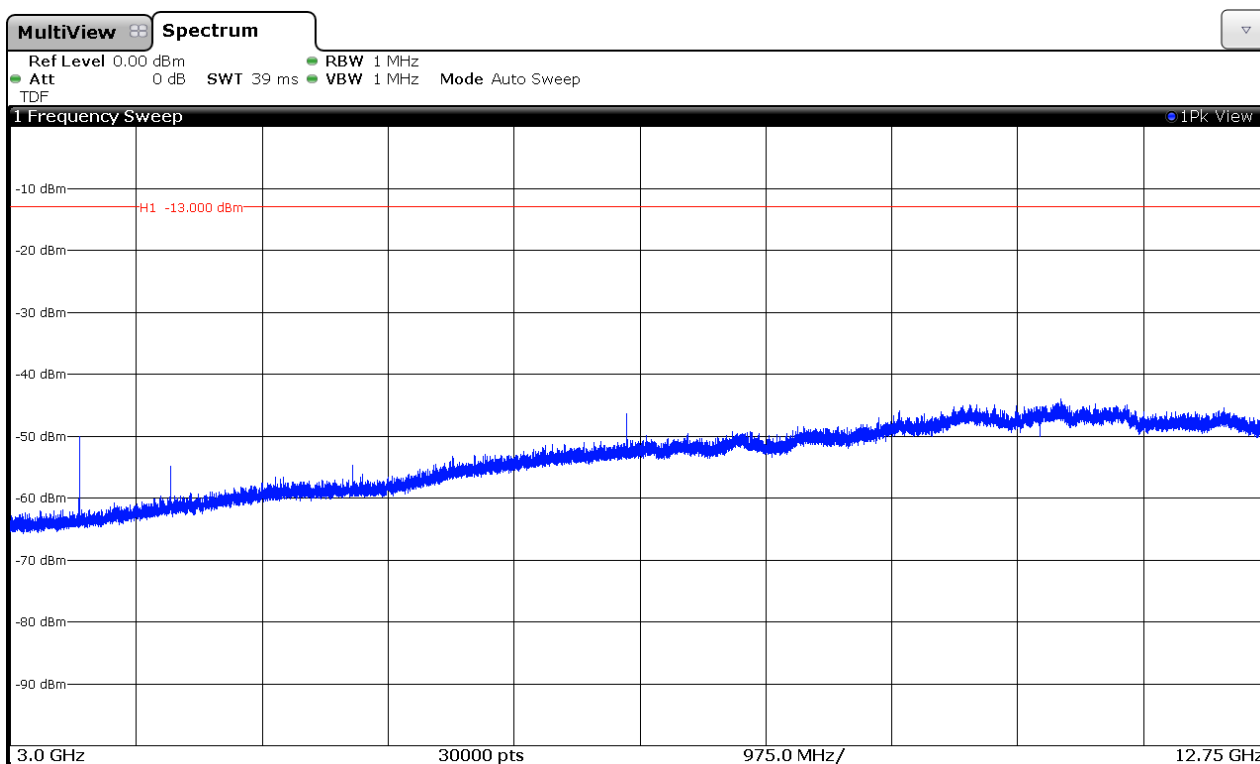
CHANNEL: HIGHEST



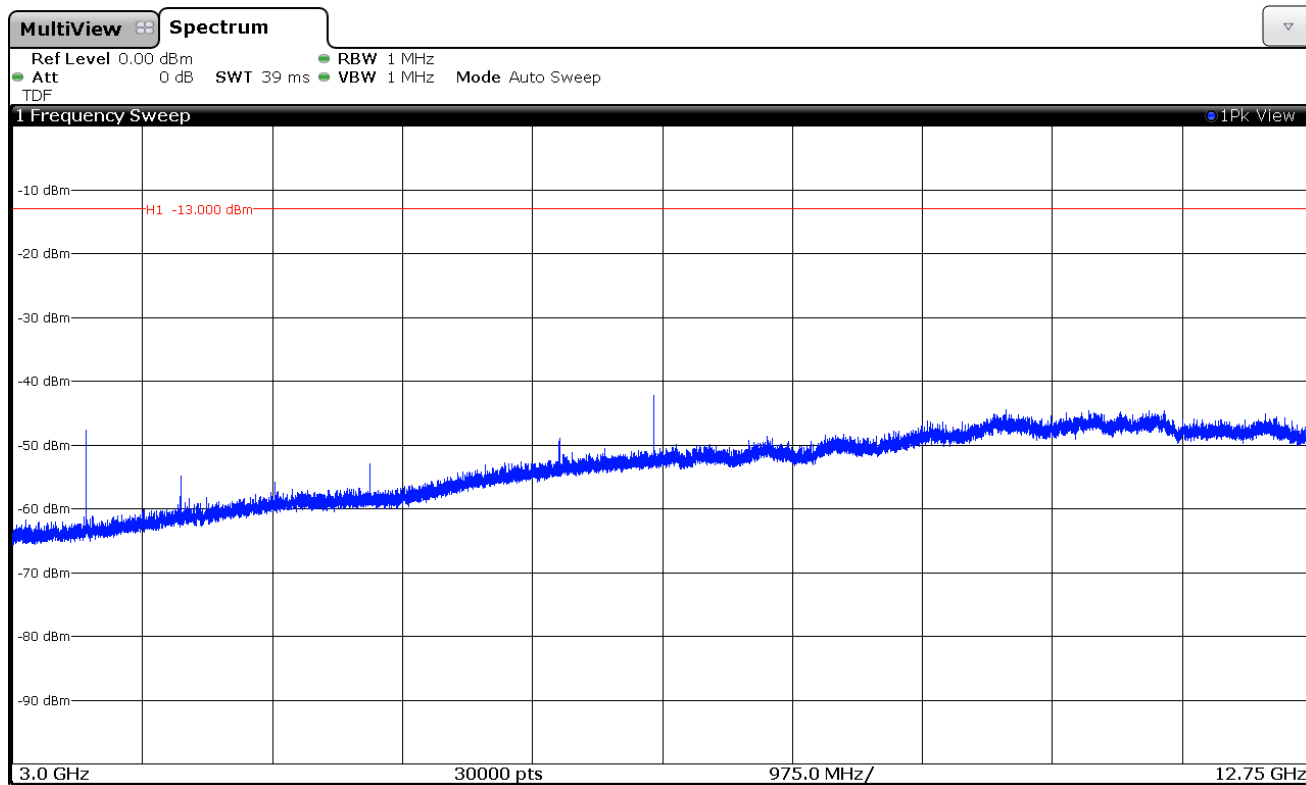
FREQUENCY RANGE 3 GHz to 12.75 GHz.

LTE QPSK MODULATION. BW=5 MHz. Band XVII

CHANNEL: LOWEST



CHANNEL: MIDDLE



CHANNEL: HIGHEST

